INSTRUCTION MANUAL

TRACKING GENERATOR

MH680B

ANRITSU CORP.

CERTIFICATION

ANRITSU CORP. certifies that this instrument has been thoroughly tested and inspected, and found to meet published specifications prior to shipping.
Anritsu further certifies that its calibration measurements are based on the Japanese Electrotechnical Laboratory and Radio Research Laboratory standards.

WARRANTY

All Anritsu products are warranted against defects in material and workmanship. The warranty is effective for one year from the date of delivery. In the event of improper use, abuse, or damage due to natural catastrophe, the warranty will become void. Anritsu will repair or replace products which prove to be defective during the warranty period, provided they are returned to Anritsu.
No other warranty is expressed or implied.
All requests for repairs and replacement parts should be directed to Anritsu or its representative in your area.

N O T E

(1) The instrument is operable on a nominal voltage of 100 to 127 Vac or 200 to 254 Vac by changing the connections of the power transformer taps. (See circuit diagram 1 in Section 6.)

The voltage and current rating are indicated on the rear panel.

When changing voltages, change the connections of the power supply transformer, and the voltage and current designation plate on the rear panel. Order the plates from ANRITSU CORP. if necessary.

(2) In this manual, supply voltage and current rating are represented by [**] Vac and [***] A.

(3) The relationships between power supply voltage and current rating are listed below.

**Vac	***A
100 to 127 V	0.315 A
200 to 254 V	0.2 A

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SECTION 1

GENERAL

The MH680B Tracking Generator is used in conjunction with the MS610B Spectrum Analyzer as a wideband sweep signal generator which measures amplitude vs. frequency response by direct observation. The output frequency of the MH680B when used with the MS610B can be set in the range from 100 kHz to 2 GHz by using the MS610B frequency dial.

The output level of the MH680B can be varied continuously in the range from -10 to 0 dBm.

The MH680B, with the MS610B, can be used to measure the frequency response of filters, amplifiers, and attenuators. The device under measurement can be adjusted while directly observing the characteristics on the MS610B CRT display.

Also the MH680B with the MS610B and a frequency counter, can be used to measure the accurate frequency and frequency response.

Impedance can be measured by direct observation using a directional coupler or a reflection bridge.

SECTION 2

COMPONENTS AND SPECIFICATIONS

2.1 Components

Item	No.	Name	Q'ty	Remarks
Equip-ment	1	MH680B Tracking generator	1	
Acces-sories supplied	2	Coaxial cable/1m	1	S-5DWP•5D2W•S-5DWP
	3	Coaxial cable/0.5m	2	HRM202•Special 3D2W•HRM202
	4	Coaxial cable/0.5m	1	3CV-P2•3C2V•3CV-P2
	5	Power cord	1	Adaptor attached
	6	Fuse		*** A, time lag fuse
	7	Instruction manual	1	

2.2 Specifications

Frequency range	100 kHz to 2 GHz
Output level range	0 to -10 dBm, continuously variable
Output level accuracy	1 dB (for an output level of 0 dBm at the end of the attached cable).
Power	** Vac ±10%, 48 to 63 Hz, $\leq$30 VA
Ambient temperature, rated range of use	0 to 50°C
Dimensions and weight	88 H x 284 W x 351 D mm, $\leq$7 kg

SECTION 3

OPERATION

3.1 Precautions

3.1.1 Power supply

The MH680B operates on ** Vac ±10%, 48 to 63 Hz (See NOTE at the beginning of this manual).

CAUTION

1. To avoid electric shock, ground the ⏚ terminal on the rear panel or ground the ground terminal of the power cord when power is supplied from a double-pole wall socket.

2. Make sure that the power switch is turned off and the power supply cord is unplugged whenever replacing fuses.

3.1.2 Environmental conditions of installation site

The MH680B normally operates under an ambient temperature of 0° to 50°C. Do not use or store the instrument in locations.

1. where vibrations are severe.
2. where it is damp or dusty.
3. where there is exposure to direct sunlight.
4. where there is exposure to active gases.

CAUTION

When the MH680B is to be used at room temperature after having been used at low temperatures such as 0°C for a long period of time, condensation may occur and cause short circuiting. Be sure to allow the MH680B to dry completely before turning on the power.

3.1.3 Maximum input level

[+20 dBm, or 25 V dc]:

Input exceeding this level may damage the internal circuitry.

3.2 Explanation of Controls

The arrangements of the front and rear panels are shown in Figs. 3-1 and 3-2.

Table 3-1 Explanation of Controls

No.	Level	Explanation
#1	POWER ON/OFF	Power switch. A lamp is lit when power is on.
#2	TRACKING ADJ	Compensates for the frequency tracking errors when using the Spectrum Analyzer MS610B.
#3	LEVEL VERNIER	Adjust the output level.
#4	50 Ω	Signal output connector
#5	AUX OUTPUT	Output connector for frequency counter
#6	GATE TIME (ms) 0.1 1 4 10	Frequency counter gate time setting switch
#7	FIRST LOCAL INPUT	Input connector for the MS610B lst local oscillator signal used for tracking
#8	SECOND LOCAL INPUT	Input connector of the MS610B 2nd local oscillator signal used for tracking
#9	RESET OUTPUT TO COUNTER	Output connector for frequency counter reset signal
#10	CONTROL INPUT TO MS610B	Input connector for control signal from MS610B
#11	AC **V	Ac inlet for power cord connection.
#12	*** A	Ac fuses. Make sure that the power switch is turned off and the power supply cord is unplugged whenever replacing fuses.
#13	⏚	Ground terminal. Be sure to ground to avoid electric shock.

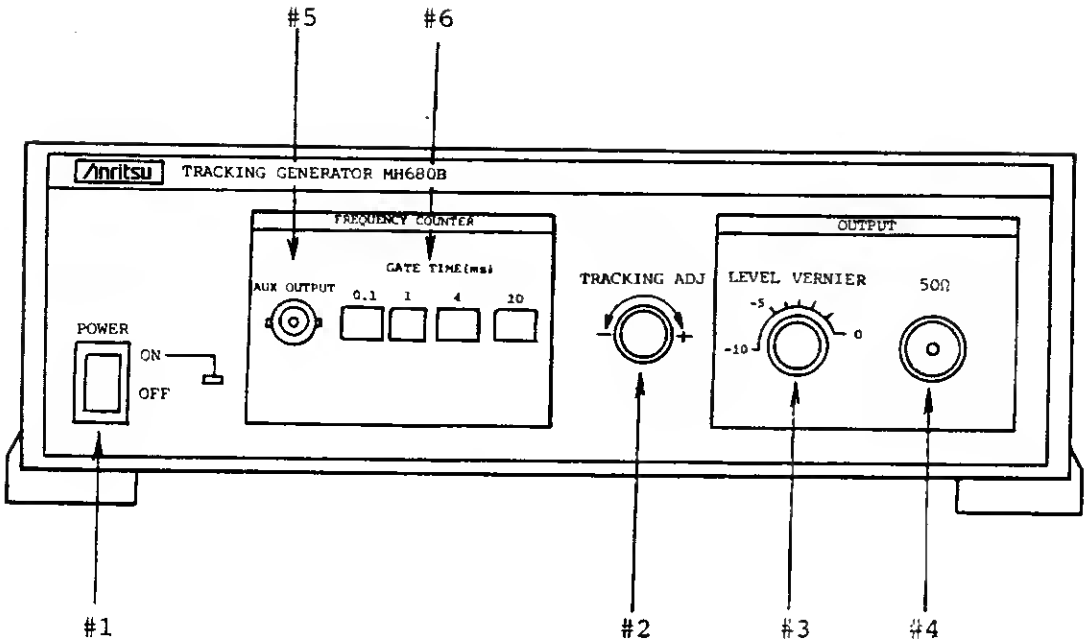


Fig. 3-1 Front panel

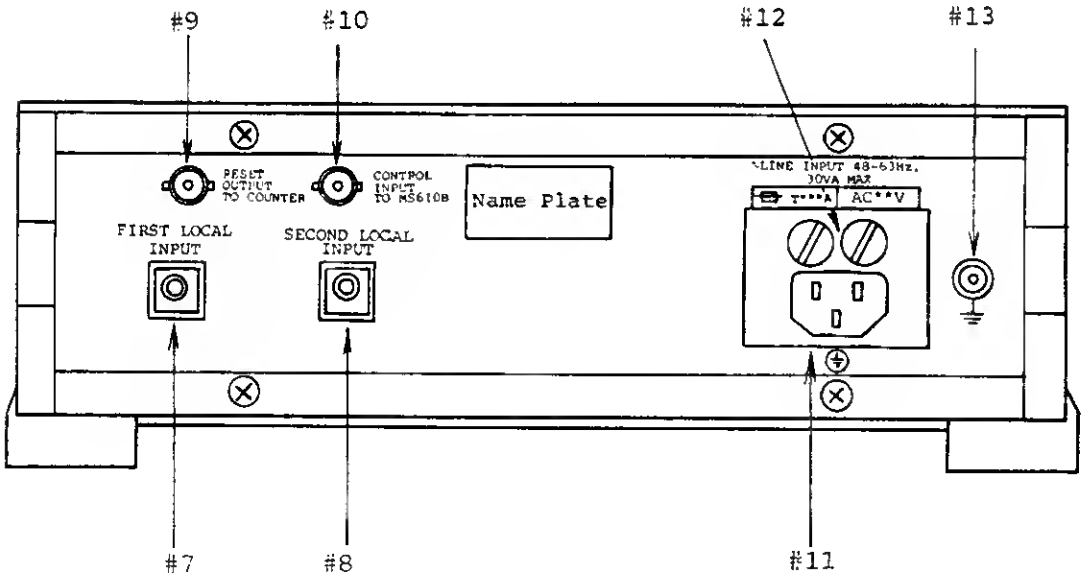


Fig. 3-2 Rear panel

3.3 Measurement

3.3.1 Measurement Preparations

CAUTION

Confirm that the ac line voltage corresponds to the rated voltage before turning the power switch on.

(1) As shown in Fig. 3-3, connect the FIRST LOCAL INPUT and SECOND LOCAL INPUT connectors on the MH680B rear panel to the corresponding LOCAL OUTPUT connectors on the MS610B rear panel by using the supplied coaxial cable.

On frequency measurement, connect the CONTROL OUT TO MH680B connector of the MS610B to the CONTROL INPUT TO MS610B connector of the MH680B, also connect the RESET connector of the frequency counter to the RESET OUTPUT TO COUNTER connector of the MH680B, and the INPUT connector of frequency counter to the AUX OUTPUT connector of the MH680B.

(2) Calibrate the MS610B using its built-in CAL signal. (For calibrating, refer to the MS610B operation manual.)

(3) Check the tracking operation in conjunction with the MS610B as follows:

(a) Connect the MH680B output connector to the MS610B input connector using the supplied coaxial cable.

(b) Set the MS610B and MH680B as follows:

MS610B:	FREQ SPAN	FULL SPAN
	COUPLED TO SPAN	ON
	REFERENCE LEVEL	5.0 dBm
	SCALE	2 dB/DIV
MH680B:	LEVEL VERNIER	0 dB

The tracking frequency response shown in Fig. 3-4 is displayed on the MS610B CRT screen.

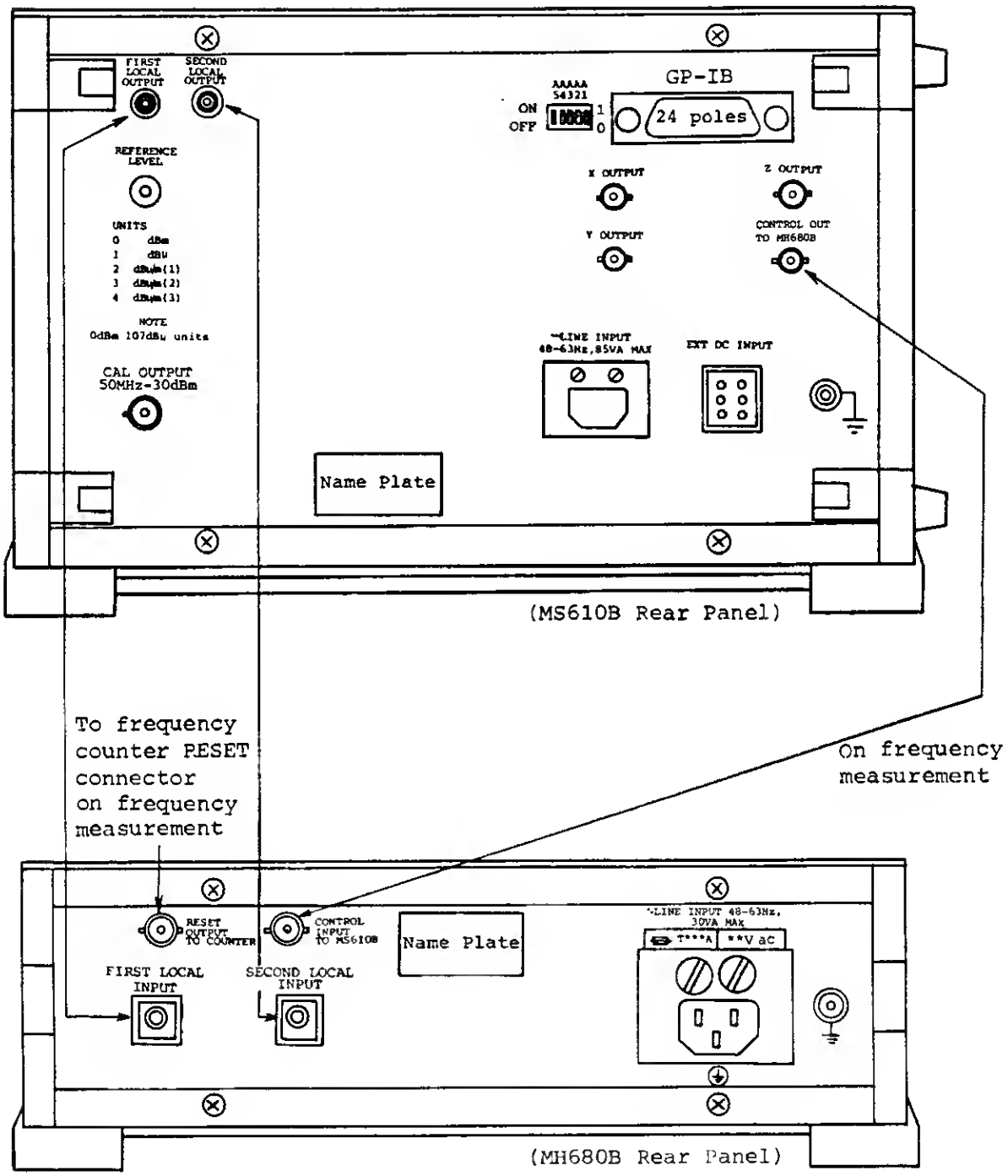


Fig. 3-3 Rear Panel LOCAL INPUT Connections with the MS610B

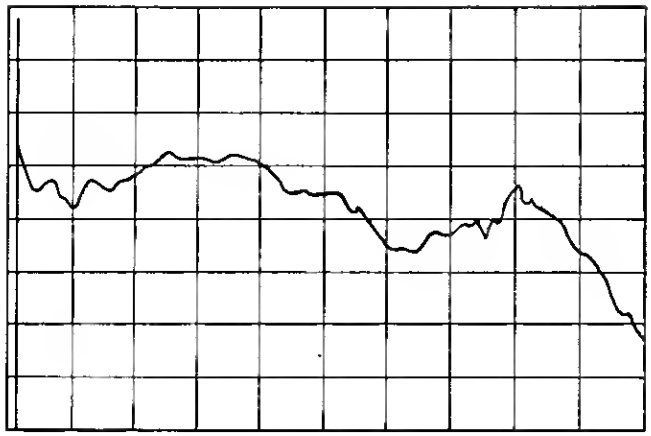


Fig. 3-4 Tracking Frequency Response (MS610B)

3.3.2 Measurement Precautions

(1) Tracking adjustment

When the MS610B is operated at RBW 100 kHz or less, the reception level down may be affected by frequency tracking errors.

If this occurs, adjust the reception level to the maximum level by using the TRACKING ADJUST knob.

This adjustment must be made for every RBW setting.

(2) Impedance matching

The output impedance of the MH680B is 50 Ω. When the nominal impedance of the device under test is other than 50 Ω, the device must be measuring by using an impedance converter. The transmission error resulting from the mismatching between input and output impedances of VSWR 1.5 is approximately 0.4 dB. When a transmission error of 1 dB or less is desired, we recommend that a matching pad be inserted, even for the measurement of a 50 Ω device.

The maximum mismatch error can be calculated by using the following expression:

$$L = 10 \log_{10} (1 - K^2) \ [dB]$$

$$K = \frac{VSWR-1}{VSWR+1}$$

(3) Maximum input level

Pay attention to the operation level ranges of the device under test and the MH680B. Especially note any abnormal output of the amplifier when the maximum output level exceeds +20 dBm, or any excessive output of the amplifier due to abnormal oscillation.

Maximum input level of MS610B:
+20 dBm, 0 Vdc

Maximum reverse input level of MH680B:
+20 dBm, 25 Vdc

(4) Sweep time

When the device under test has a long delay time, such as a long optical fiber and a filter with a high, steep slope of attenuation in a narrow band, the correct frequency response may not be displayed if the MS610B sweep time is too short.

Set the MS610B sweep time in a range in which the frequency response curve is not affected by changing the sweep time to the longer sweep time. After this setting is made, correct measurement can be performed.

3.3.3 Measurement

(1) Amplifier measurement

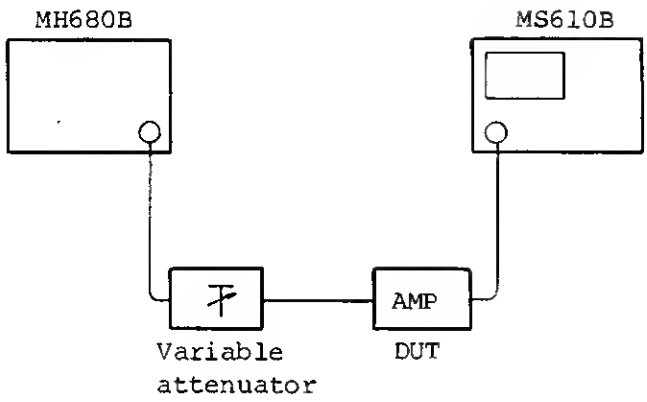


Fig. 3-5 Setup

Step	Procedure
1	As shown in Fig. 3-5, connect an attenuator and an amplifier (device under test).
2	Set the MS610B according to the frequency and the level ranges of the amplifier.
3	Adjust the variable attenuator and set the amplifier input level to the level less than the amplifier saturation point.

(2) Measurement with improved frequency accuracy

Using the MH680B and Anritsu counter, measurement with improved frequency accuracy can be performed. When correctly calibrated, the frequency accuracy is within 3% of the frequency span width. The setup is shown in Fig. 3-6.

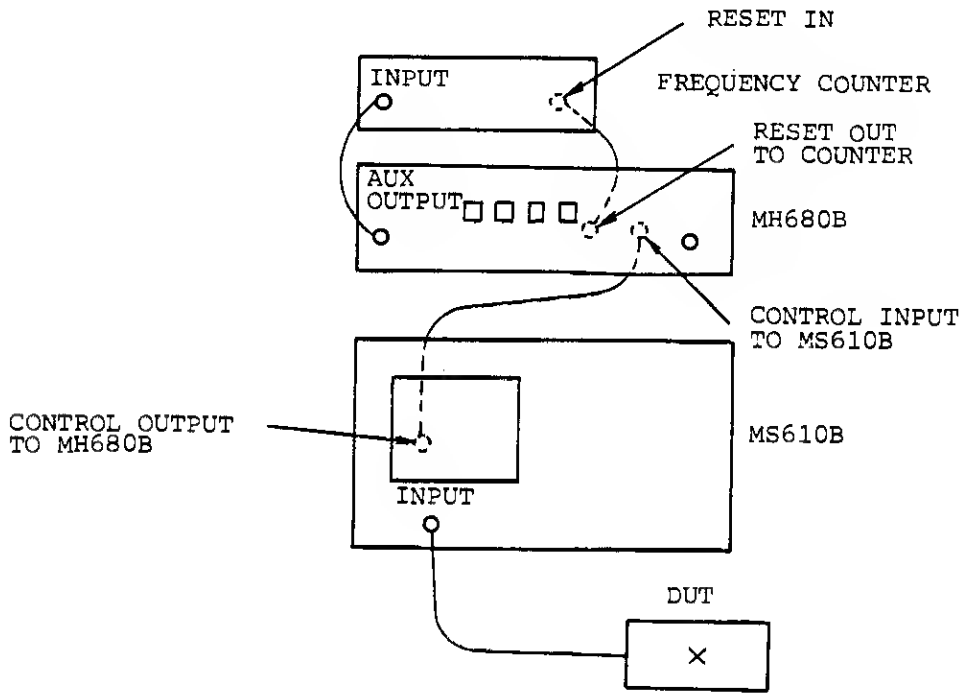


Fig. 3-6 Setup

(a) Frequency calibration

The frequency must be calibrated for each RBW setting of the MS610B. When RBW exceeds 100 kHz, calibrate at RBW 10 kHz.

Step	Procedure
1	Connect the MS610B RF INPUT connector to the MH680B OUTPUT connector using the supplied coaxial cable.
2	Set the MS610B as follows: FREQ SPAN 0 Hz RBW Set 10 kHz when the setting of the RBW to be measured exceeds 100 kHz. Otherwise, set to the RBW to be measured. SCALE 2 dB/DIV
3	Adjust the MH680B LEVEL VERNIER and the MS610B REFERENCE LEVEL as required so that the signal is displayed at the screen center.
4	Turn the MH680B TRACKING ADJ volume so that the displayed signal is at the maximum value.

(b) MH680B setting

Set the GATE TIME (ms) so that it matches the counter gate time.

GATE TIME range: 0.1, 1, 4, and 10 ms

When using an Anritsu counter, set as shown in the table below.

Table 3-2 Gate Time Setting

Type	Frequency Range	Counter Resolution Setting		MH680B GATE TIME setting
		Resolution	Gate Time	
MF57A/58A	10 Hz to 600 MHz	1 kHz	1 ms	1 ms
		100 Hz	10 ms	10 ms
MF63A/64A	Input 1 10 Hz to 60 MHz	1 kHz	1 ms	1 ms
		100 Hz	10 ms	10 ms
	Input 2 30 to 1000 MHz	1 kHz	4 ms	4 ms

When using another counter type, the MH680B volume must be adjusted.

(c) Frequency measurement

Step	Procedure
1	Receive the unknown signal at the MS610B screen center.
2	Set the sweep time to 0.1, 0.2, 0.5, or 1 s. If another sweep time is set, the counter will not operate. Note: Frequency measurement is more stable if a longer sweep time is set.
3	Set the MARKER on. The counter starts operating.
4	Turn the frequency setting dial so that the received signal is set at the zone marker center as shown in Fig. 3-7.

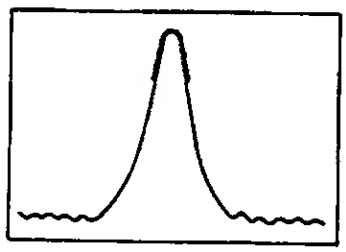


Fig. 3-7 Zone Marker

	The accurate frequency of this signal is at the zone marker center.
5	Read the counter displayed frequency.

Note:

1. Measuring equipment frequency response is included in the measurement value.

   To obtain the correct frequency response of the device under test, subtract the measuring equipment frequency response value from the measured value.

2. Measurement error

   (1) Frequency measurement error by frequency counter described in this paragraph is expressed as span width error. This error is less than ±3% of the span width. For example, the error is ±3 kHz for a span width of 100 kHz.

   When span width is 0.5 GHz, the error becomes ±15 MHz and this error is larger than the MS610B/J frequency display accuracy (±10 MHz).

   Frequency measurement by counter is useful at a span width of less than 0.1 GHz.

   (2) Frequency measurement stability depends on the span width.

   This is approximately 0.5% of the span width and sufficient for the marker setting. To obtain more stable measurement, reduce the span width accordingly.

(3) Filter measurement

(a) Filter measurement compared with a reference device

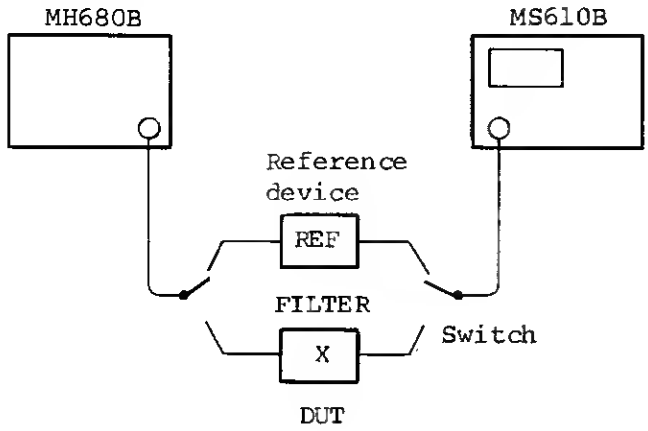


Fig. 3-8 Setup

Step	Procedure
1	As shown in Fig. 3-8, connect a reference device and a device under test through switches.
2	Set the MH680B and the MS610B according to the frequency and the level ranges of the reference device.
3	Set the switches to connect the device under test to the measuring system and adjust the device to have the same frequency response as the reference device.
4	Alternately switch to confirm that the frequency responses of the reference device and the device under test are the same.

(b) Filter measurement with improved frequency accuracy

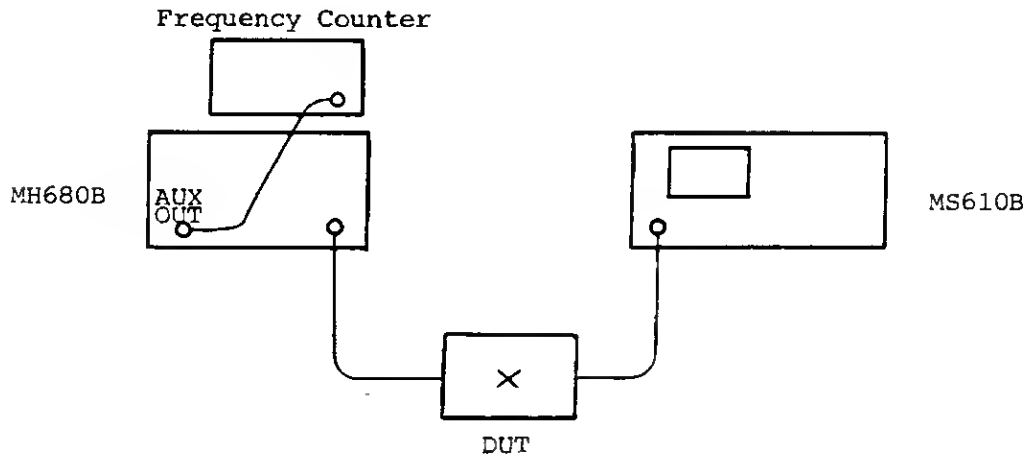


Fig. 3-9 Setup

Step	Procedure
1	Connect a device under test (DUT) as shown in Fig.3-9.
	Connect the rear panels of the MS610B and MH680B and the counter as shown in Fig. 3-6.
2	Set the MH680B and MS610B as required so that the filter characteristics are displayed on the CRT.
3	Use the RBW set value to calibrate the frequency, as explained in paragraph 3.3.3 (2) (a).
4	Set the MARKER on.
5	Turn the frequency tuning dial so that the zone marker center is at the preset frequency.
6	While observing the CRT, adjust the DUT.

(Cont'd)

Step	Procedure
7	Confirm the DUT characteristics from the counter display frequency and the MS610B level display.

Note: Relationship between MS610B display level and counter display frequency is shown below.

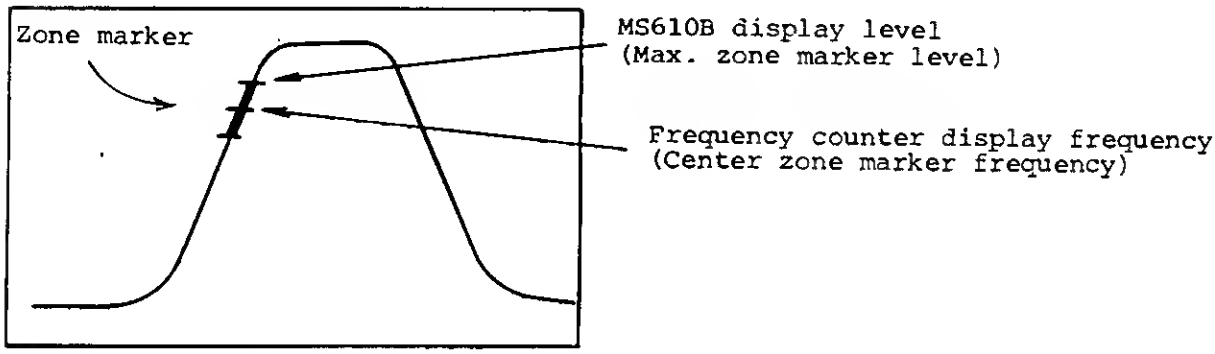


Fig. 3-10 Relationship between MS610B Display Level and Counter Display Frequency

Note: During the filter measurement described above, ripples may occur in the passband due to the measurement system impedance. In such a case, connect attenuators to the input and the output terminals of the filter to improve the impedance matching (e.g., 6 dB PAD).

(4) Impedance measurement

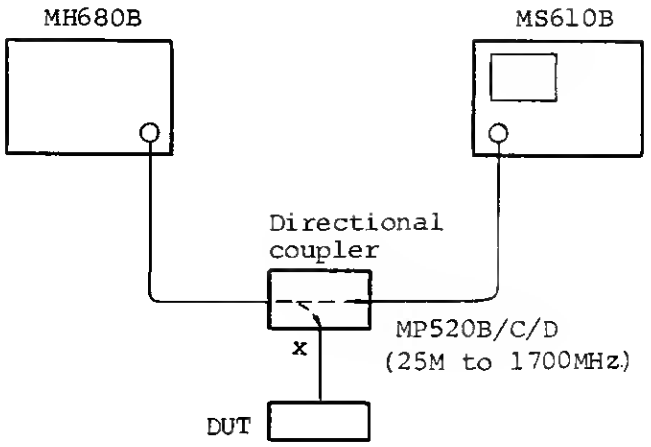


Fig. 3-11 Setup

STEP	PROCEDURE
1	As shown in Fig. 3-11, connect a directional coupler. (Do not connect a device under test.)
2	Set the MH680B and the MS610B according to the frequency and the level ranges of the device under test. The measurement value is the reference value for this setting.
3	Connect the device under test to the terminal X of the directional coupler. Subtract the reference value of step 2 from the measurement value of this step. This subtracted value is the return loss.

Note: The return loss and the reflection coefficient are calculated as follows.

Return loss

$$\delta = 20 \log_{10} \frac{Zx+Ro}{Zx-Ro}$$

Reflection coefficient

$$S = \frac{Zx-Ro}{Zx+Ro}$$

VSWR

$$P = \frac{1+|S|}{1-|S|}$$

Zx: Impedance of the device under test

Ro: Characteristic impedance (50 Ω)

Table 3-3 DB (Return loss) - VSWR CONVERSION TABLE

DB	VSWR	DB	VSWR	DB	VSWR	DB	VSWR	DB	VSWR
0.2	86.863	10.2	1.894	20.2	1.217	30.2	1.064	40.2	1.020
0.4	43.437	10.4	1.865	20.4	1.211	30.4	1.062	40.4	1.019
0.6	28.964	10.6	1.837	20.6	1.206	30.6	1.061	40.6	1.019
0.8	21.730	10.8	1.811	20.8	1.201	30.8	1.059	40.8	1.018
1.0	17.391	11.0	1.785	21.0	1.196	31.0	1.058	41.0	1.018
1.2	14.500	11.2	1.760	21.2	1.191	31.2	1.057	41.2	1.018
1.4	12.435	11.4	1.737	21.4	1.186	31.4	1.055	41.4	1.017
1.6	10.888	11.6	1.714	21.6	1.181	31.6	1.054	41.6	1.017
1.8	9.686	11.8	1.692	21.8	1.177	31.8	1.053	41.8	1.016
2.0	8.724	12.0	1.671	22.0	1.173	32.0	1.052	42.0	1.016
2.2	7.938	12.2	1.651	22.2	1.168	32.2	1.050	42.2	1.016
2.4	7.284	12.4	1.631	22.4	1.164	32.4	1.049	42.4	1.015
2.6	6.731	12.6	1.612	22.6	1.160	32.6	1.048	42.6	1.015
2.8	6.258	12.8	1.594	22.8	1.156	32.8	1.047	42.8	1.015
3.0	5.848	13.0	1.577	23.0	1.152	33.0	1.046	43.0	1.014
3.2	5.490	13.2	1.560	23.2	1.149	33.2	1.045	43.2	1.014
3.4	5.174	13.4	1.544	23.4	1.145	33.4	1.044	43.4	1.014
3.6	4.894	13.6	1.528	23.6	1.141	33.6	1.043	43.6	1.013
3.8	4.644	13.8	1.513	23.8	1.138	33.8	1.042	43.8	1.013
4.0	4.419	14.0	1.499	24.0	1.135	34.0	1.041	44.0	1.013
4.2	4.216	14.2	1.484	24.2	1.131	34.2	1.040	44.2	1.012
4.4	4.032	14.4	1.471	24.4	1.128	34.4	1.039	44.4	1.012
4.6	3.864	14.6	1.458	24.6	1.125	34.6	1.038	44.6	1.012
4.8	3.711	14.8	1.445	24.8	1.122	34.8	1.037	44.8	1.012
5.0	3.570	15.0	1.433	25.0	1.119	35.0	1.036	45.0	1.011
5.2	3.440	15.2	1.421	25.2	1.116	35.2	1.035	45.2	1.011
5.4	3.320	15.4	1.409	25.4	1.114	35.4	1.035	45.4	1.011
5.6	3.209	15.6	1.398	25.6	1.111	35.6	1.034	45.6	1.011
5.8	3.106	15.8	1.387	25.8	1.108	35.8	1.033	45.8	1.010
6.0	3.010	16.0	1.377	26.0	1.106	36.0	1.032	46.0	1.010
6.2	2.920	16.2	1.367	26.2	1.103	36.2	1.031	46.2	1.010
6.4	2.836	16.4	1.357	26.4	1.101	36.4	1.031	46.4	1.010
6.6	2.758	16.6	1.347	26.6	1.098	36.6	1.030	46.6	1.009
6.8	2.684	16.8	1.338	26.8	1.096	36.8	1.029	46.8	1.009
7.0	2.615	17.0	1.329	27.0	1.094	37.0	1.029	47.0	1.009
7.2	2.549	17.2	1.320	27.2	1.091	37.2	1.028	47.2	1.009
7.4	2.488	17.4	1.312	27.4	1.089	37.4	1.027	47.4	1.009
7.6	2.430	17.6	1.304	27.6	1.087	37.6	1.027	47.6	1.008
7.8	2.375	17.8	1.296	27.8	1.085	37.8	1.026	47.8	1.008
8.0	2.323	18.0	1.288	28.0	1.083	38.0	1.025	48.0	1.008
8.2	2.274	18.2	1.281	28.2	1.081	38.2	1.025	48.2	1.008
8.4	2.227	18.4	1.273	28.4	1.079	38.4	1.024	48.4	1.008
8.6	2.182	18.6	1.266	28.6	1.077	38.6	1.024	48.6	1.007
8.8	2.140	18.8	1.259	28.8	1.075	38.8	1.023	48.8	1.007
9.0	2.100	19.0	1.253	29.0	1.074	39.0	1.023	49.0	1.007
9.2	2.062	19.2	1.246	29.2	1.072	39.2	1.022	49.2	1.007
9.4	2.025	19.4	1.240	29.4	1.070	39.4	1.022	49.4	1.007
9.6	1.990	19.6	1.234	29.6	1.068	39.6	1.021	49.6	1.007
9.8	1.957	19.8	1.228	29.8	1.067	39.8	1.021	49.8	1.006
10.0	1.925	20.0	1.222	30.0	1.065	40.0	1.020	50.0	1.006

SECTION 4

PRINCIPLES OF OPERATION

The MH680B basic principles of operation are explained with reference to Fig. 4-1.

Figure 4-1 shows the signal path and main circuit composition in conjunction with the Spectrum Analyzer MS610B.

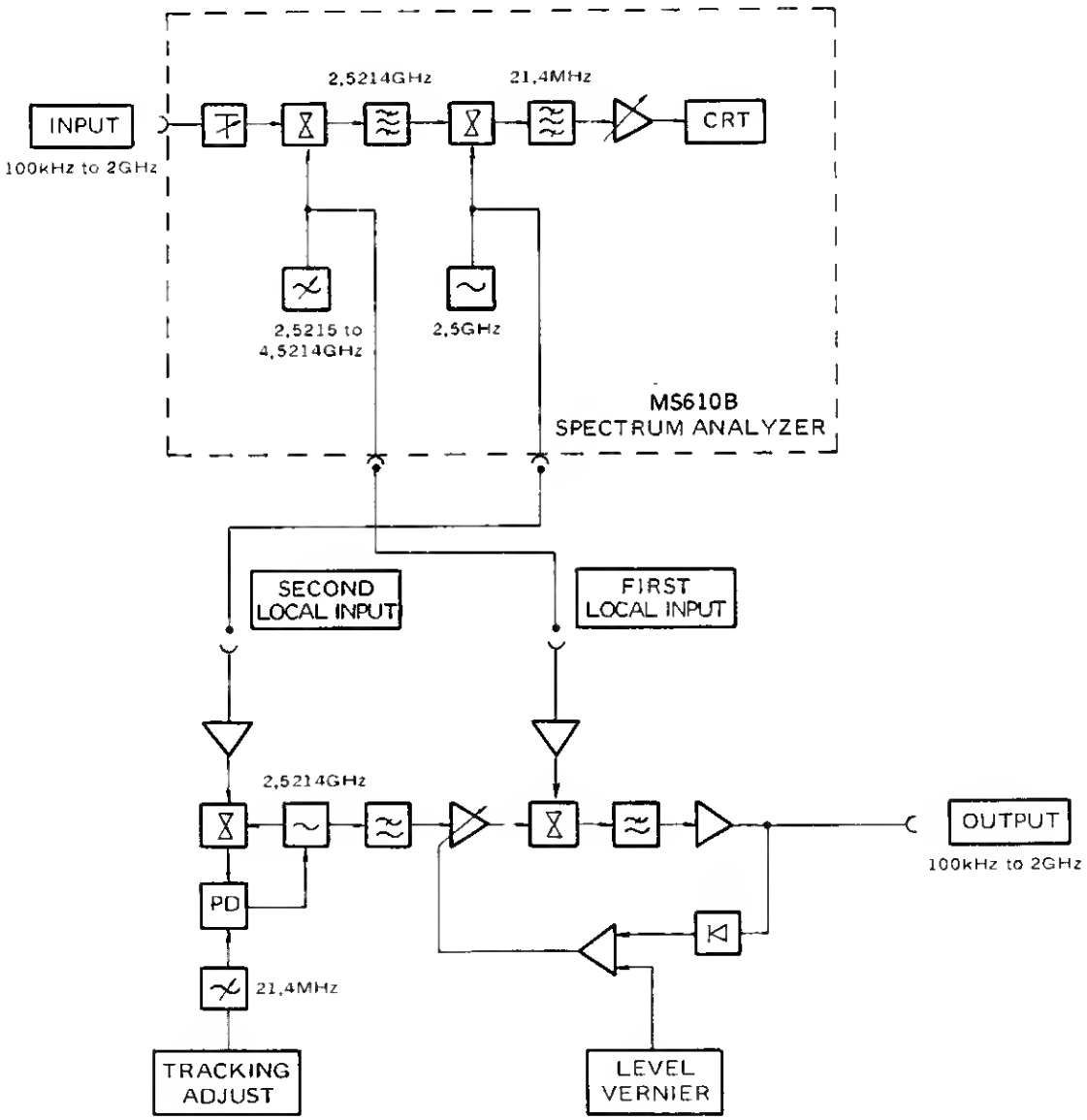


Fig. 4-1 MH680B Block Diagram

The MS610B is a super heterodyne scanning-type spectrum analyzer. Input signals are beat up to the first IF signal of 2.5214 GHz by the first local signal, then they are beat down to the second IF signal of 21.4 MHz by the second local signal (2.5 GHz). This second IF signal is amplified, detected, and displayed on the CRT screen. At this time, the first local frequency is 2.5215 to 4.5214 GHz for the receiving frequency of 100 kHz to 2 GHz.

The circuit composition of the MH680B is almost the opposite of the MS610B. The MH680B output frequency matches the MS610B receiving frequency by sharing the first and second local signals with the MS610B.

Each isolation amplifier is inserted in each local signal path to minimize the crosstalk signal between the MH680B and the MS610B.

The 2.5214 GHz VCO frequency of the MH680B that corresponds to the first IF frequency of the MS610B is converted to 21.4 MHz by the second local signal from the MS610B, and is phase-detected by the 21.4 MHz of the crystal oscillator. The phase detector outputs the voltage that corresponds to the phase difference and controls the 2.5214 GHz VCO (PLL).

This 2.5214 GHz signal is then converted to the signal from 100 kHz to 2 GHz by the first local signal from the MS610B. Then it is amplified and finally output. This output level is stabilized by an automatic level control (ALC) circuit.

The output level can be varied continuously in the range from -10 to 0 dBm by changing the ALC reference voltage.

SECTION 5

PERFORMANCE TEST

5.1 Introduction

This section describes the typical methods for testing the specified performance.

When the MH680B passes all the performance tests described in this section, it is operating normally. If any items do not satisfy the specifications, repair and adjust according to the Sections 6 and 7.

Table 5-1 List of Performance Test Items

Test Item Reference Paragraph	Test Contents
5.4.1	Frequency range
5.4.2	Output level range
5.4.3	Output level flatness
5.4.4	Power consumption

5.2 Equipment Required for Performance Test

Table 5-2 shows the equipment required for performance test of MH680B.

Table 5-2 Equipment Required for Performance Test

No.	Equipment	Required Performance	Recommended Model (Anritsu)
1	Spectrum Analyzer	Frequency range 10 kHz to 2 GHz Measuring level range -115 to +20 dBm	MS610B
2	Power Meter with Power Sensor	Frequency Range 100 kHz to 2 GHz Measuring power range -10 to 0 dBm Calibration accuracy 0.15 dB	ML83A with MA72A (10 MHz to 14 GHz)
3	Ac Meter	Ac Ammeter 0 to 10 A, ±1% Ac Voltmeter 0 to 300 V, ±1%	

5.3 Preliminary Operations

(1) Turn on the MH680B and test equipment power.

(2) Warm up the MH680B and test equipment for 1 hour or more.

5.4 Performance Test

Unless otherwise specified, verify the results of each test and troubleshoot whenever the test specification is not met.

5.4.1 Frequency range

(1) Specification

100 kHz to 2 GHz

(2) Setup

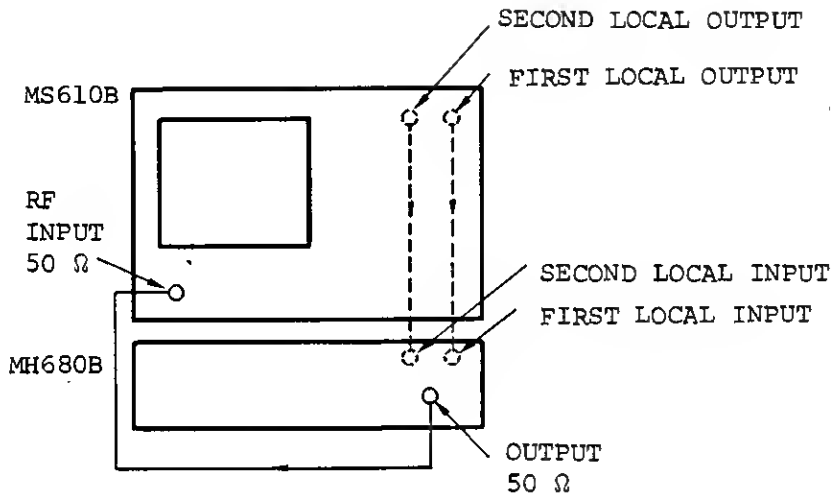


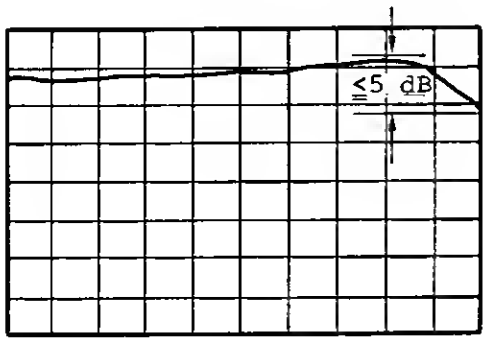
Fig. 5-1 Frequency Range Test Setup

(3) Procedure

Step	Procedure
1	Set the MS610B controls as follows: (Refer to MS610B Operation Manual) POWER ..... ON SCALE ..... 2 dB/div. REF LEVEL ... 0 dBm
2	Set the MH680B LEVEL VERNIER to 0 dBm.

(cont.)

Step	Procedure
3	Ensure that the curve (frequency characteristics) deviation indicated on the MS610B screen is lower than 5 dBp-p.



5.4.2 Output level range

(1) Specification

-10 to 0 dBm continuously variable

(2) Setup

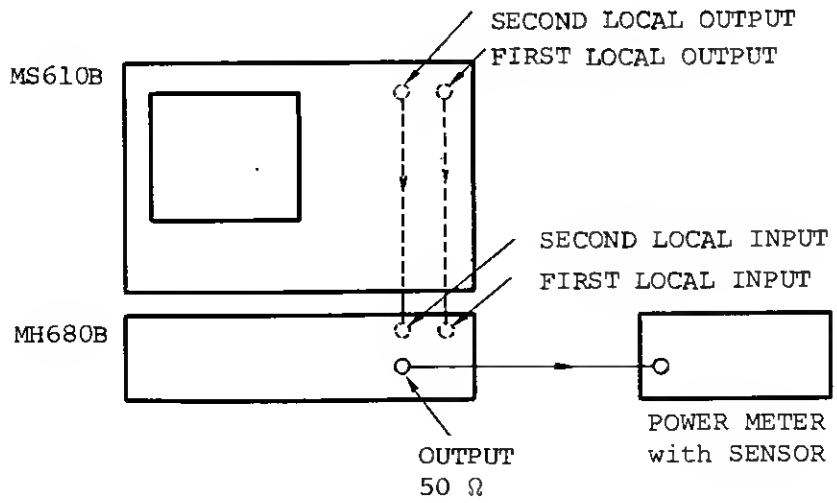


Fig. 5-2 Output Level Range and Flatness Test Setup

(3) Procedure

Set the MS610B and MH680B controls as follows:

Step	Procedure
1	Set the FREQ SPAN to 0 MHz. (Other keys can be set anywhere)
2	Set the MS610B frequency to 2 GHz.
3	Ensure that the Power Meter reading output level is continuously variable from -10 to 0 dBm by adjusting the MH680B LEVEL VERNIER.
4	Set the MS610B frequency to 50 MHz.
5	Repeat Step 3.

5.4.3 Output level flatness

(1) Specification

$\leq$1 dB (when LEVEL VERNIER is at 0)

(2) Setup

Same as the setup in Fig. 5-2

(3) Procedure

Step	Procedure
1	Repeat Step 1 in paragraph 5.4.2(3) to set the MS610B key.
2	Set the MS680B LEVEL VERNIER to 0.
3	Ensure that the Power Meter indication deviation is lower than 1 dB by adjusting the MS610B setting frequency from 100 kHz to 2 GHz.

5.4.4 Power consumption

(1) Specification

** Vac ±10%, 48 to 63 Hz, ≤30 VA

(2) Setup

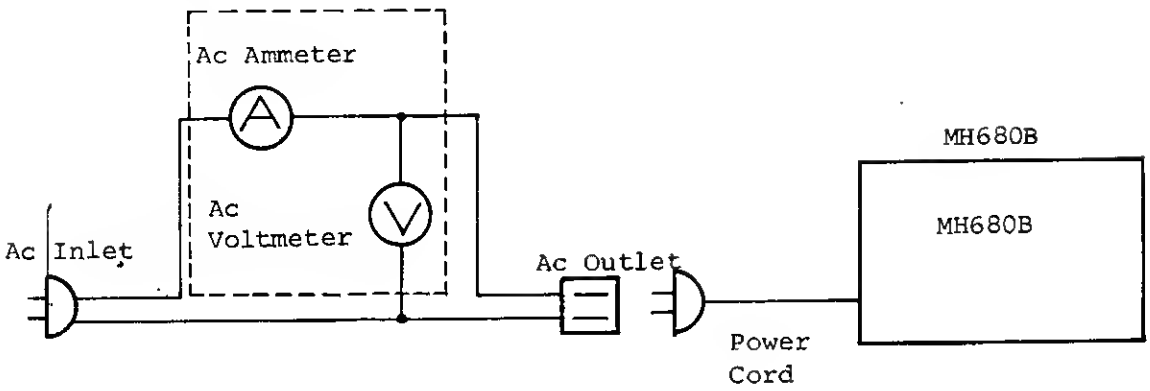


Fig. 5-3 Power Consumption Test Setup

(3) Procedure

Step	Procedure
1	Connect the measuring ac inlet to the commercial ac voltage supply inlet through the ac ammeter and ac voltmeter, as shown in Fig. 5-3.
2	Connect the MH680B accessory power supply cord to the ac outlet.
3	Set the MH680B power switch to ON. Read the value of the ac voltmeter and the ac ammeter. The power consumption value is calculated from the following formula: VA = (reading of the ac voltmeter) x (reading of ac ammeter)
4	Ensure that VA is less than 30.

SECTION 6

CIRCUIT DIAGRAM

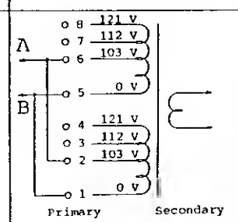
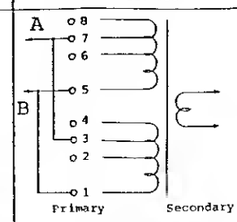
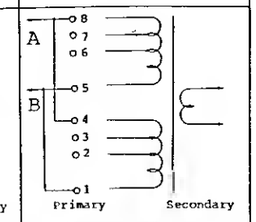
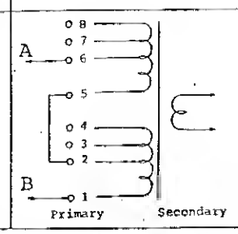
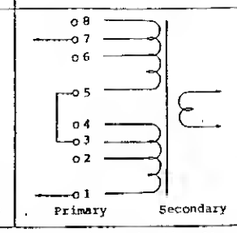
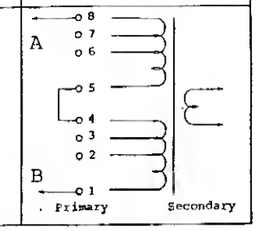
Table 6-1 Circuit Diagram List

Circuit Diagram No.	Z No.	Name	PC Board No.
1	——	MH680B TRACKING GENERATOR	——
2	Z1	RF BLOCK	——
3	Z1/Z1	OUTPUT AMP & DET	332U27176
4	Z1/Z3	EQUALIZER	322U9739
5	Z1/Z5	ALC AMP	332U27178
6	Z1/Z7	CONVERTER	332U27180
7	Z1/Z8	SECOND LOCAL AMP	332U27182
8	Z1/Z9	FIRST LOCAL AMP (2)	332U27184
9	Z1/Z10	FIRST LOCAL AMP (1)	332U27186
10	Z1/Z11	21.4 MHz P.D.	342U87831
11	Z2	POWER SUPPLY	342U86441
12	Z3	COUNTER CONTROL	332U28059

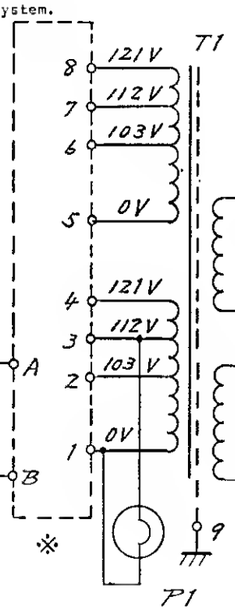
APPLICATION

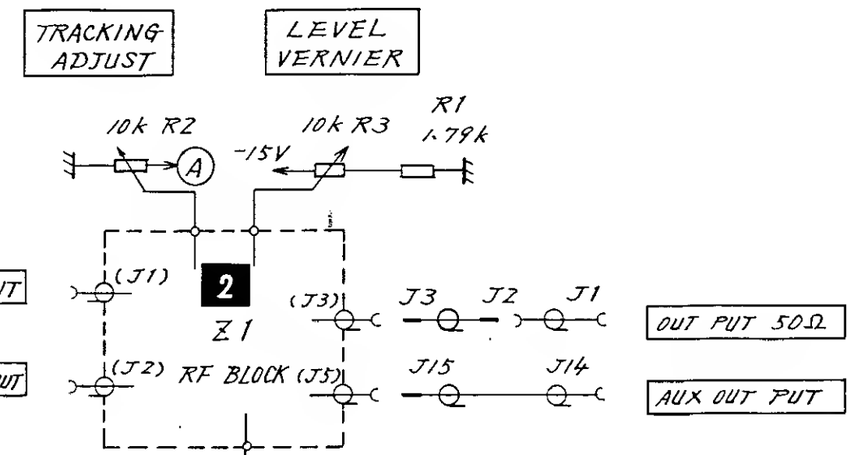
REVISIONS

Transformer Tap Connection

Nominal Line Voltage	100 - 108 Vac	108 - 117 Vac	117 - 127 Vac
100 V System			
Nominal Line Voltage	200 - 216 Vac	216 - 234 Vac	234 - 254 Vac
200 V System			

All the tap voltage ratings are the same as shown in the figure of 100-108 Vac system.





Parts List | 34W89637

QTY	ITEM	PART No.	DESCRIPTION	MATERIAL	FINISH	NOTE

CHECKED BY	TRACED BY
APPROVED BY	DRAWN BY

SCALE :

TITLE MH680B TRACKING GENERATOR Circuit Diagram.

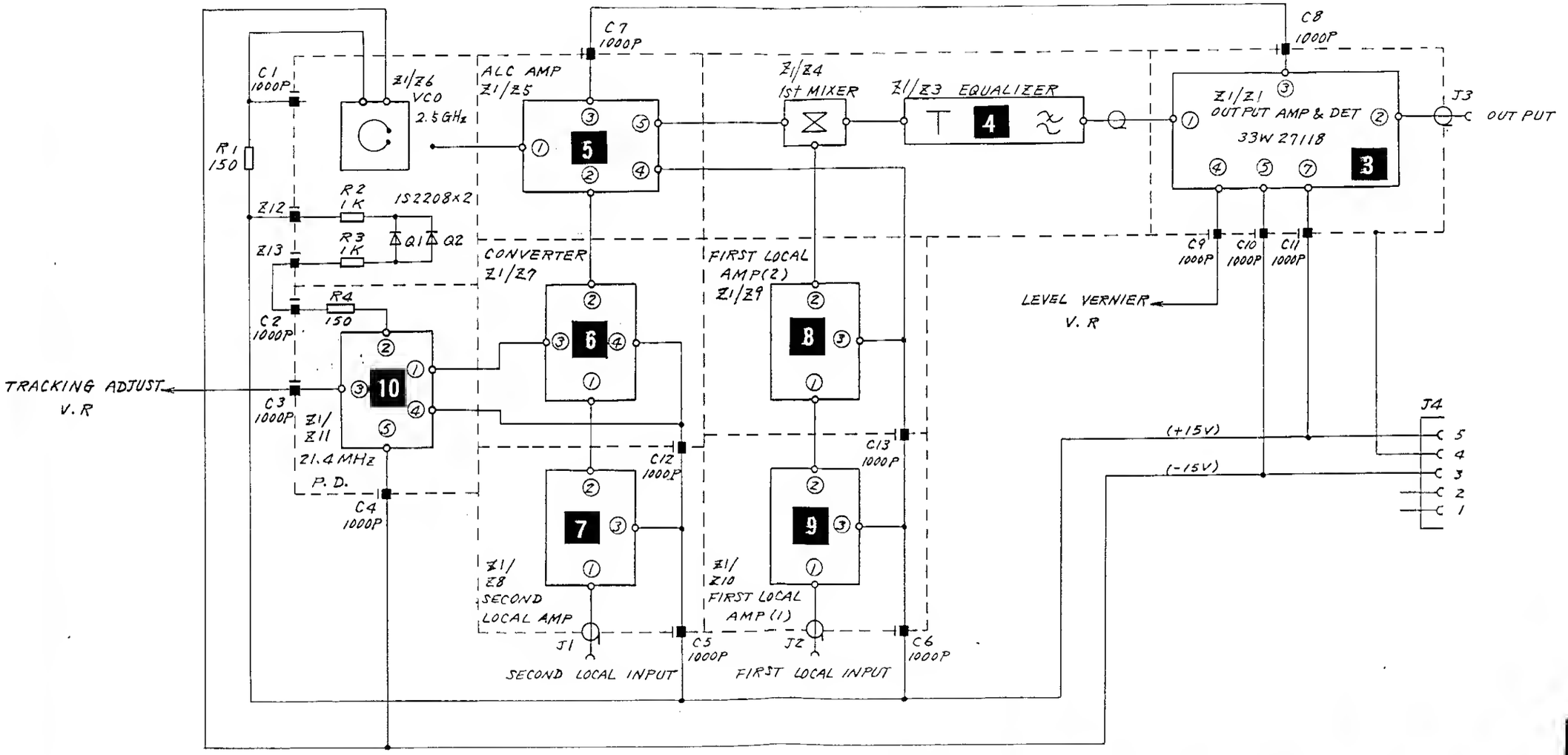
DRAWING No. 33W28115 1/1

DEP

33W27126 1/1

APPLICATION

REVISIONS



2

Parts List 34W87284

QTY	ITEM	PART No.	DESCRIPTION	MATERIAL	FINISH	NOTE

CHECKED BY	TRACED BY	SCALE
APPROVED BY	DRAWN BY	

TITLE (MH680 A/B)

Z1 RF BLOCK Circuit Diagram

DRAWING No. 33W27126 1/1

OEP

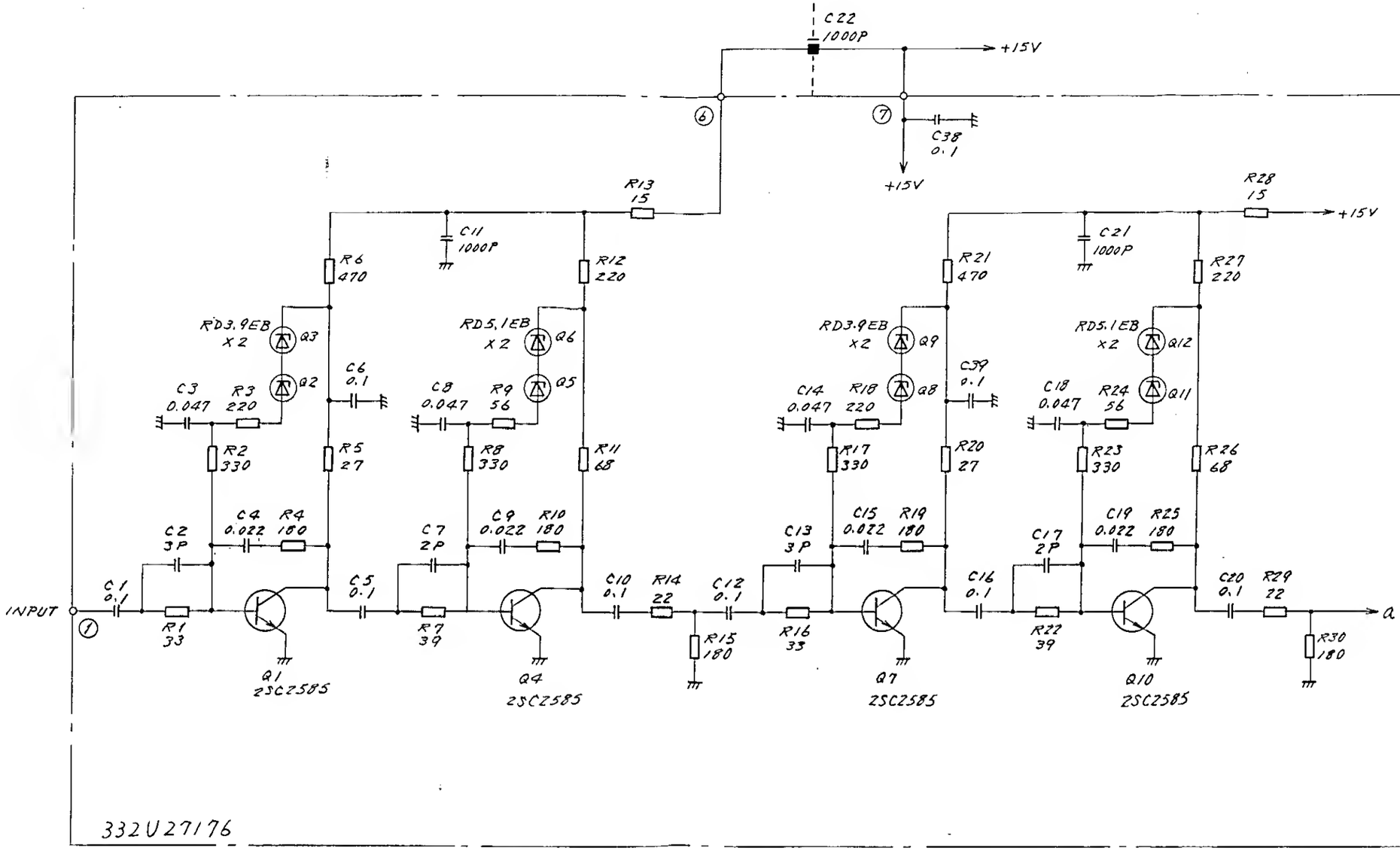
ANRITSU CORP

6-5/6-6

33W27118 1/2

APPLICATION

REVISIONS



332U27176

3

QTY	ITEM	PART No.	DESCRIPTION	MATERIAL	FINISH	NOTE

CHECKED BY | TRACED BY | SCALE

APPROVED BY | DRAWN BY

TITLE Z1/Z1 (MH680A/B)
OUTPUT AMP & DET Circuit Diagram

DRAWING No. 33W27118 1/2

Parts List 34W87274

DEP

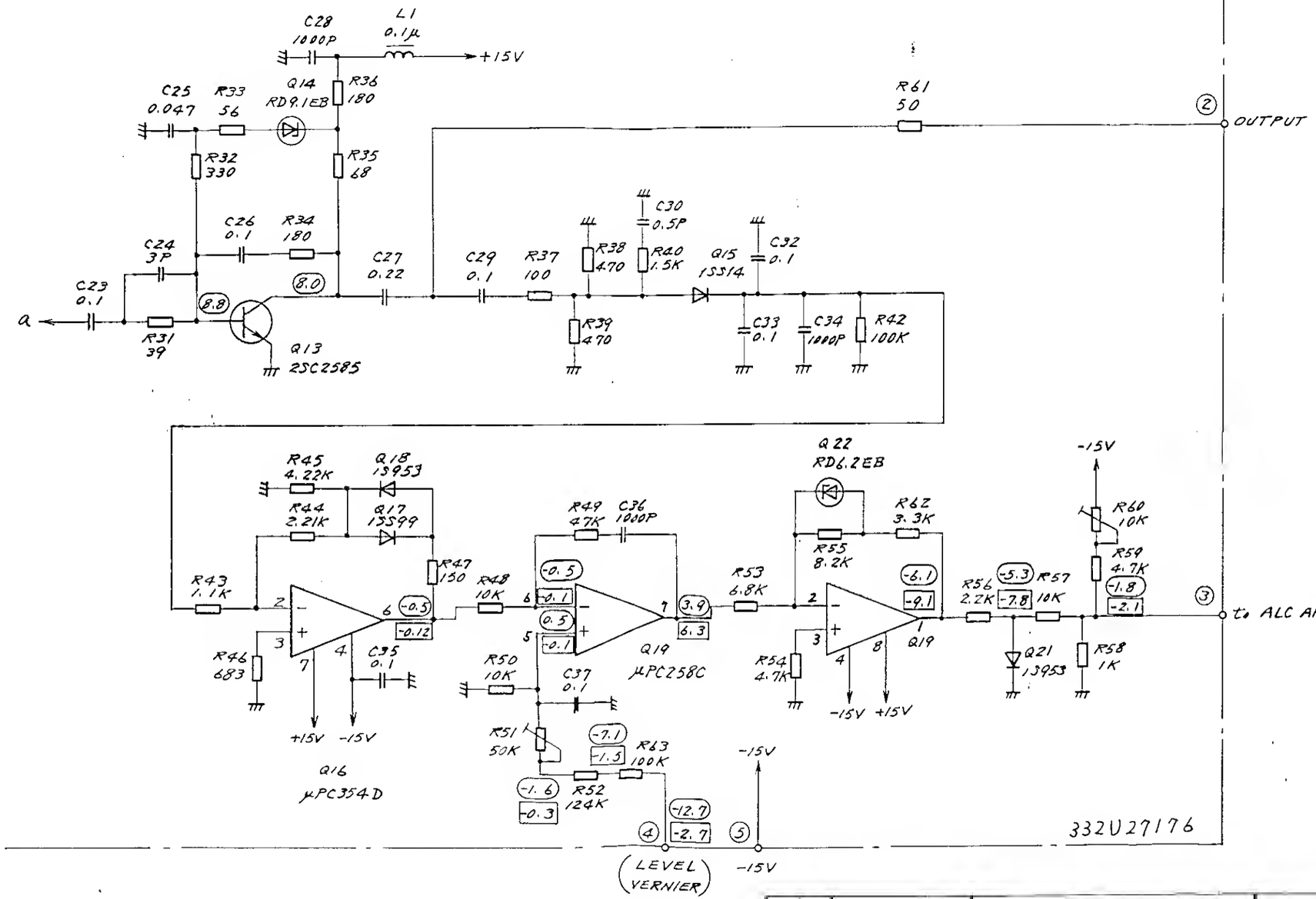
No. 0023-1985.08

ANRITSU CORP

6-7/6-8

APPLICATION

REVISIONS



3

Note:

◯ Voltage is when LEVEL VERNIER is 0

□ Voltage is when LEVEL VERNIER is -10

Parts List 34W87274

QTY	ITEM	PART No.	DESCRIPTION	MATERIAL	FINISH	NOTE

CHECKED BY | TRACED BY | SCALE

APPROVED BY | DRAWN BY

TITLE Z1/Z1 (MH680A/B)

OUTPUT AMP & DET Circuit Diagram

DRAWING No. 33W27118 2/2

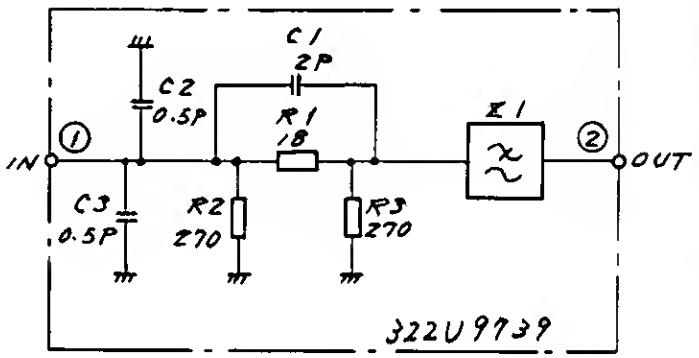
ANRITSU CORP.

6-9/6-10

DEP

34W87273 1/1

APPLICATION	REVISIONS



Parts List 34W87275

4

QTY	ITEM	PART No.	DESCRIPTION	MATERIAL	FINISH	NOTE

CHECKED BY	TRACED BY	SCALE
APPROVED BY	DRAWN BY	:

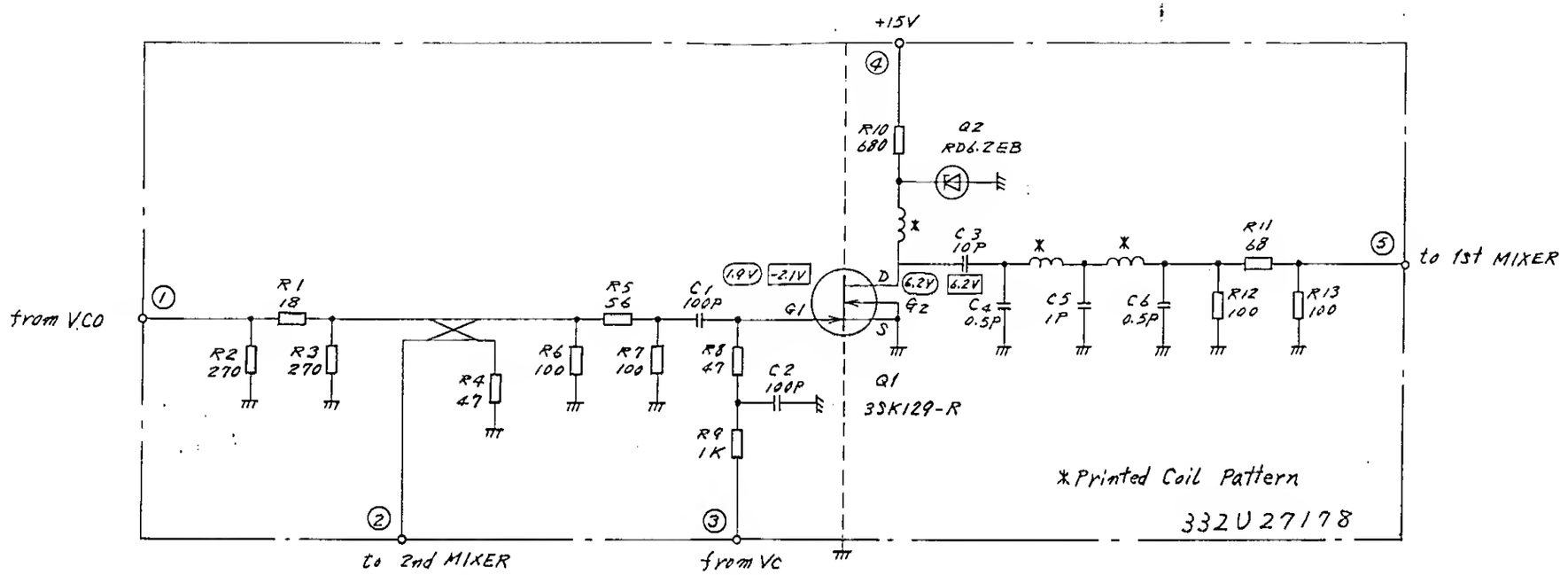
DEP

TITLE Z1/Z3 (MH680A/B)
EQUALIZER Circuit Diagram

DRAWING No. 34W87273 1/1

APPLICATION

REVISIONS



Note: ⬭ Voltage is when LEVEL VERNIER is 0
▭ Voltage is when LEVEL VERNIER is -10

5

Parts List	34W87276

QTY	ITEM	PART No.	DESCRIPTION	MATERIAL	FINISH	NOTE

CHECKED BY | TRACED BY | SCALE :

APPROVED BY | DRAWN BY

TITLE Z1/Z5 (MH680A/B) ALC AMP Circuit Diagram

DRAWING No. 33WZ7119 1/1

DEP

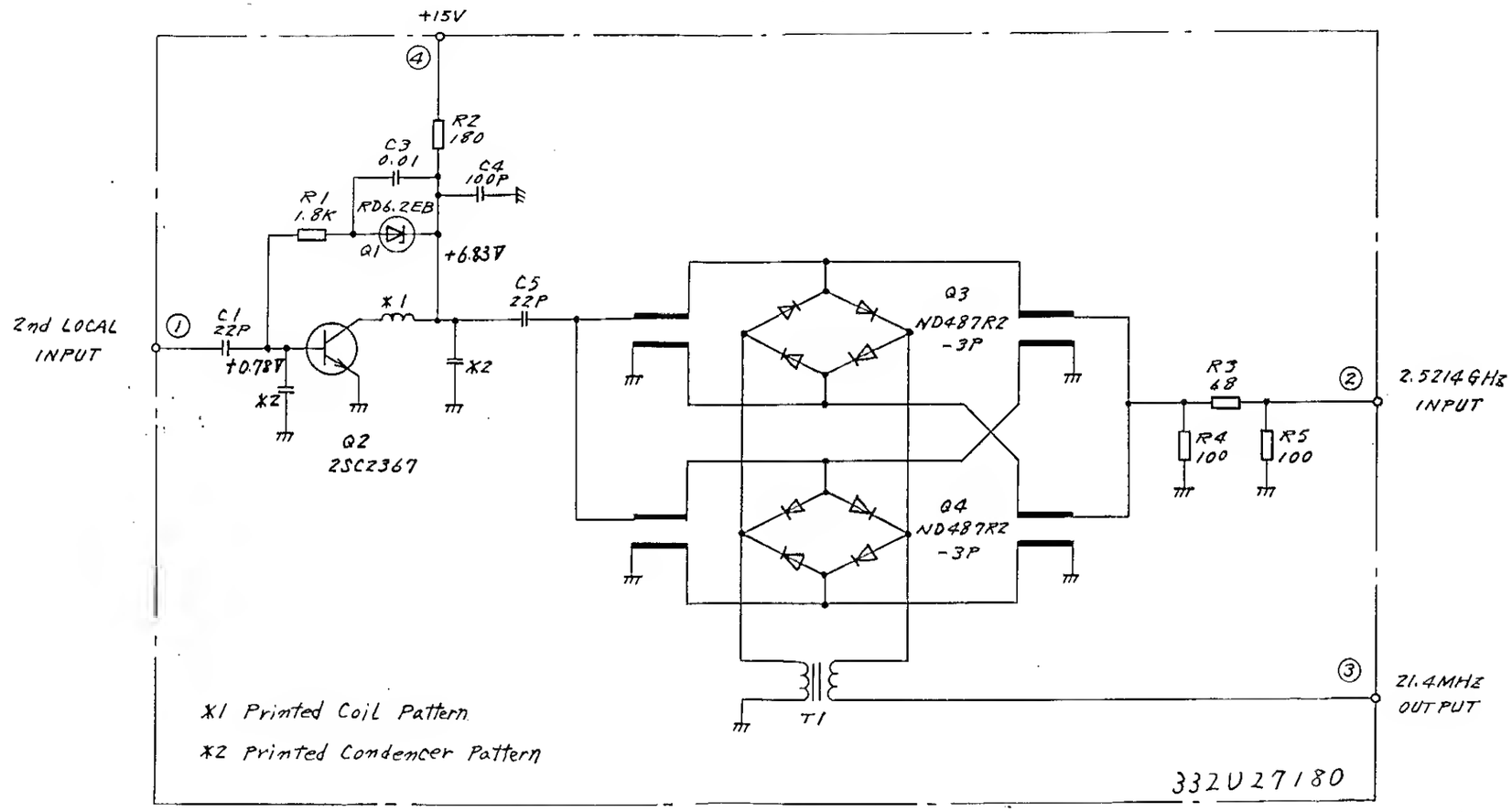
ANRITSU CORP.

6-13/6-14

33W27120 1/1

APPLICATION

REVISIONS



6

QTY	ITEM	PART No.	DESCRIPTION	MATERIAL	FINISH	NOTE

CHECKED BY | TRACED BY | SCALE

APPROVED BY | DRAWN BY

TITLE Z1/Z7 (MH680A/B) CONVETER Circuit Diagram

DRAWING No. 33W27120 1/1

Parts List 34W87277

DEP

No. D023-1985.08

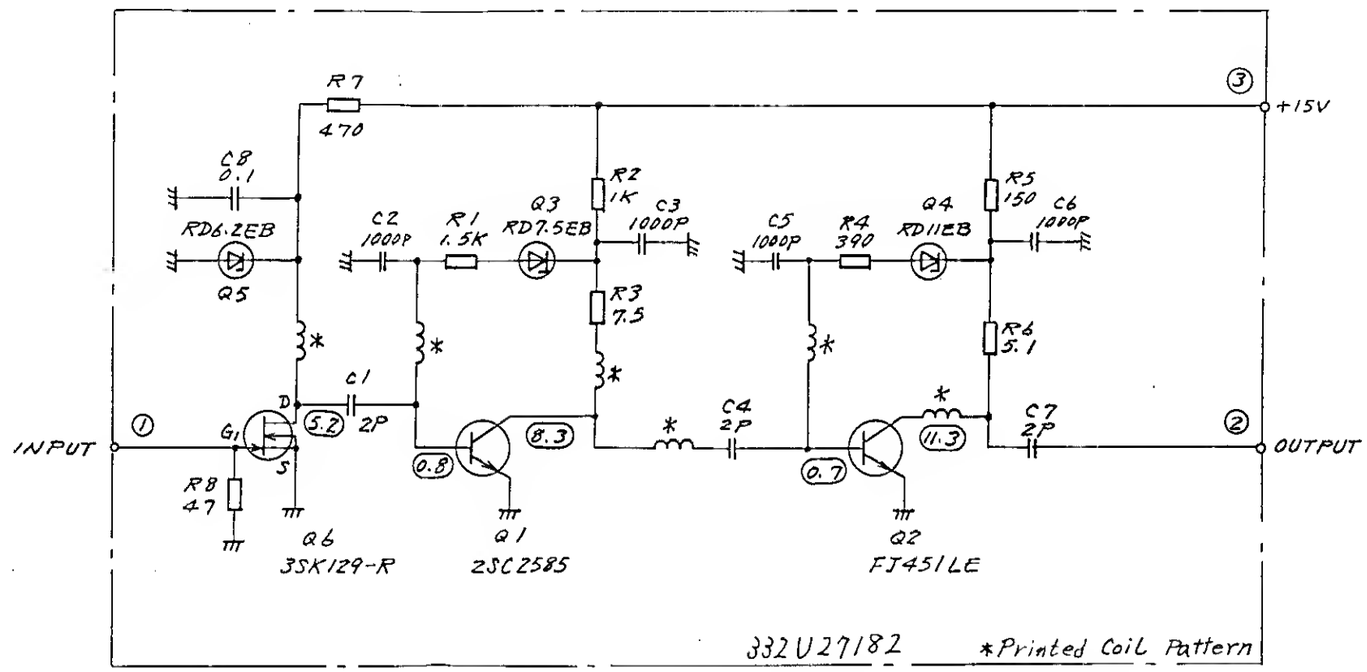
ANRITSU CORP.

6-15/6-16

33W27121 1/1

APPLICATION

REVISIONS



332U27182 *Printed Coil Pattern

Note:
○ Voltage is when LEVEL VERNIER is 0
□ Voltage is when LEVEL VERNIER is -10

Parts List 34W87278

7

QTY	ITEM	PART No.	DESCRIPTION	MATERIAL	FINISH	NOTE
CHECKED BY		TRACED BY		SCALE		
APPROVED BY		DRAWN BY		:		

TITLE Z1/Z8 (MH680A/B)
SECOND LOCAL AMP Circuit Diagram

DRAWING No. 33W27121 1/1

DEP

No. 0023-1985.08

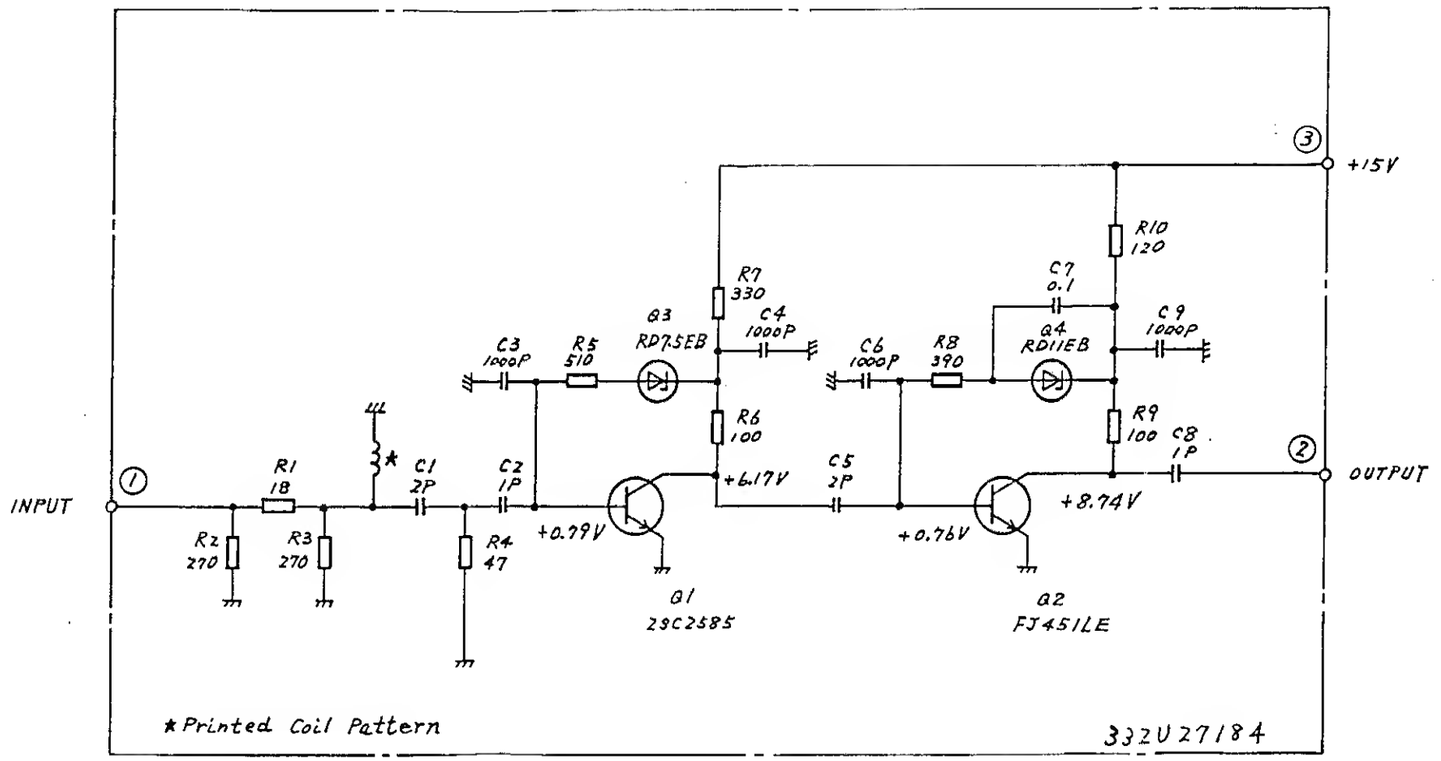
ANRITSU CORP.

6-17/6-18

33W27122 1/1

APPLICATION

REVISIONS



Parts List : 34W87279

8

QTY	ITEM	PART No.	DESCRIPTION	MATERIAL	FINISH	NOTE

CHECKED BY	TRACED BY	SCALE
APPROVED BY	DRAWN BY	

TITLE Z1/Z9 (MH680 A/B)
FIRST LOCAL AMP (2) Circuit Diagram

DRAWING No. 33W27122 1/1

DEP

No. 0023-1985.08

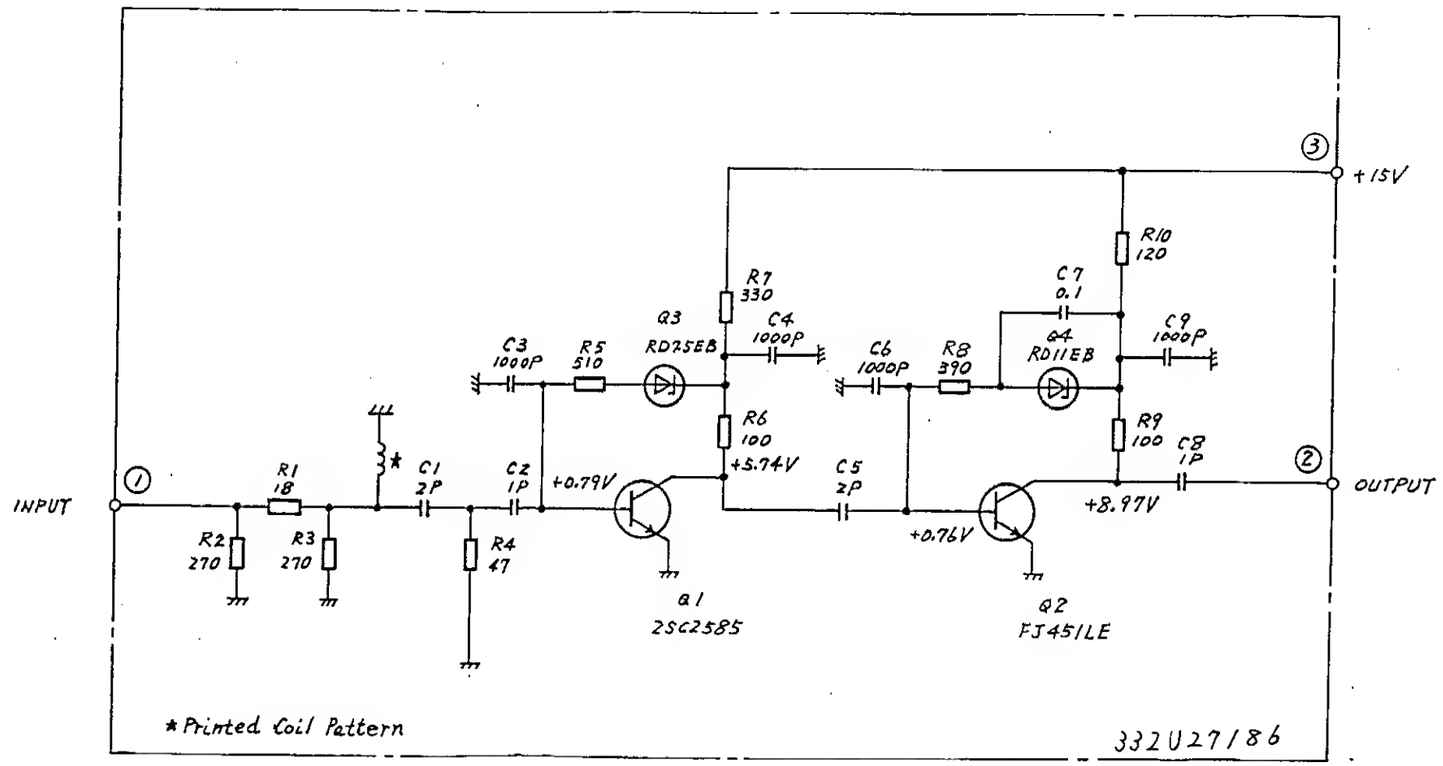
ANRITSU CORP.

6-19/6-20

33W27123 1/1

APPLICATION

REVISIONS



Parts List : 34W87280

9

QTY	ITEM	PART No.	DESCRIPTION	MATERIAL	FINISH	NOTE
CHECKED BY		TRACED BY		SCALE		
APPROVED BY		DRAWN BY		:		

TITLE Z1/Z10 (MH680A/B)
FIRST LOCAL AMP (1) Circuit Diagram

DRAWING No. 33W27123 1/1

DEP

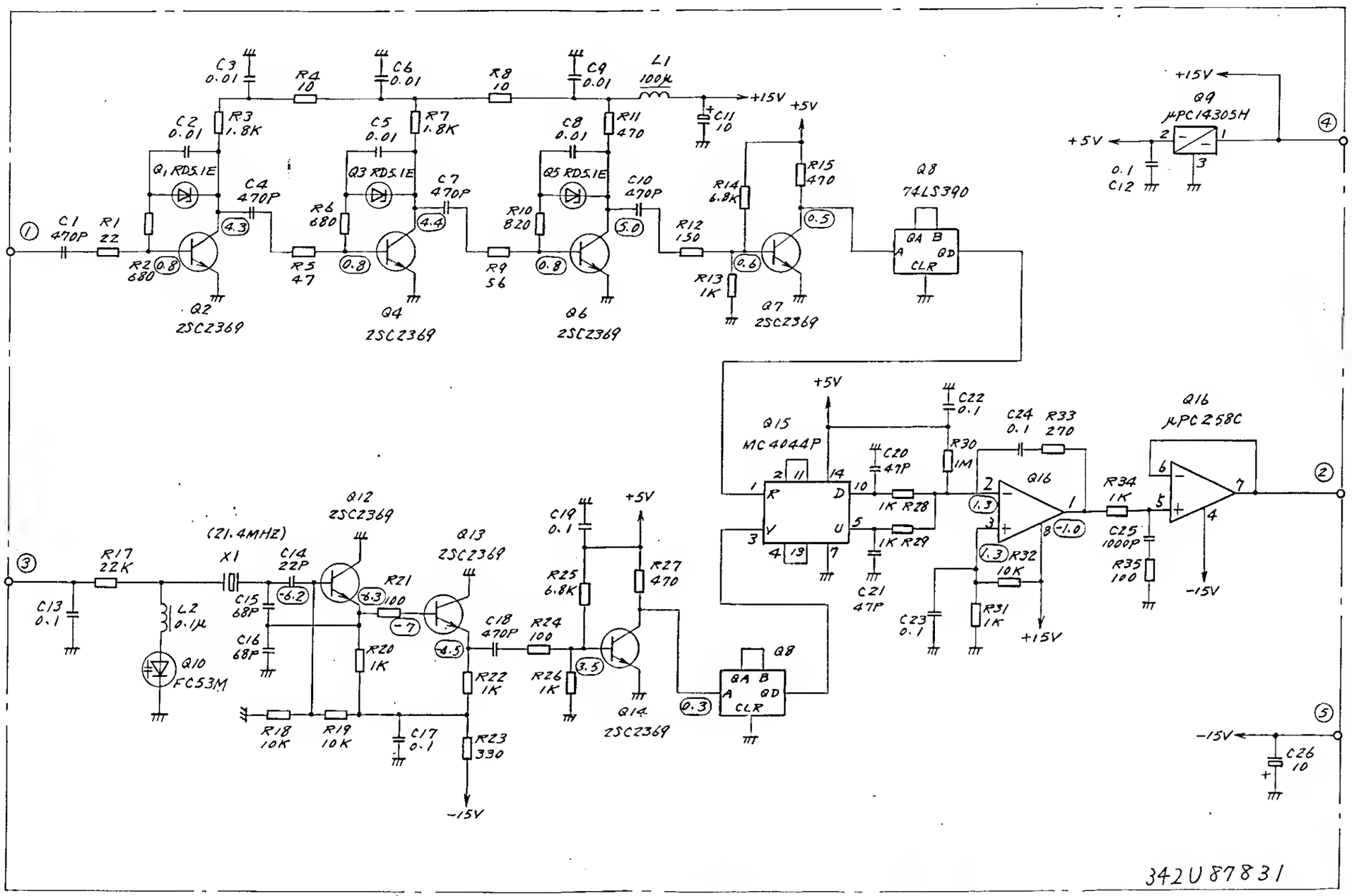
ANRITSU CORP

6-21/6-22

33W27124 1/1

APPLICATION

REVISIONS



10

Note:

○ Voltage is when LEVEL VERNIER is 0

□ Voltage is when LEVEL VERNIER is -10

Parts List 34W87281

QTY	ITEM	PART No.	DESCRIPTION	MATERIAL	FINISH	NOTE
CHECKED BY		TRACED BY		SCALE		
APPROVED BY		DRAWN BY				

TITLE Z1/Z11 (MH680A/B)
21.4MHz P.D. Circuit Diagram

DRAWING No. 33W27124 1/1

DEP

No. 0023-1985.08

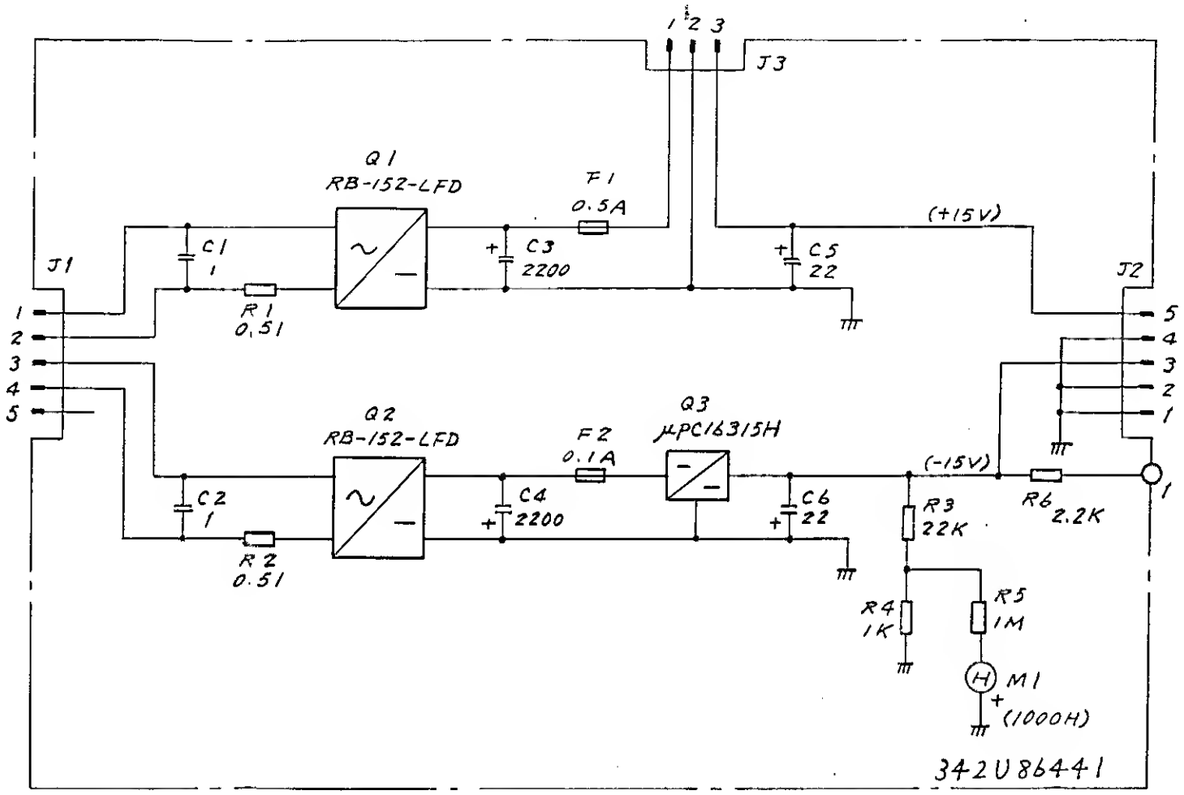
ANRITSU CORP

6-23/6-24

33W27125 1/1

APPLICATION

REVISIONS



11

Parts List 34W87282

QTY	ITEM	PART No.	DESCRIPTION	MATERIAL	FINISH	NOTE

CHECKED BY	TRACED BY	SCALE
APPROVED BY	DRAWN BY	

TITLE Z2 (MH680A/B)
POWER SUPPLY Circuit Diagram

DRAWING No. 33W27125 1/1

DEP

No. D023-1985.0B

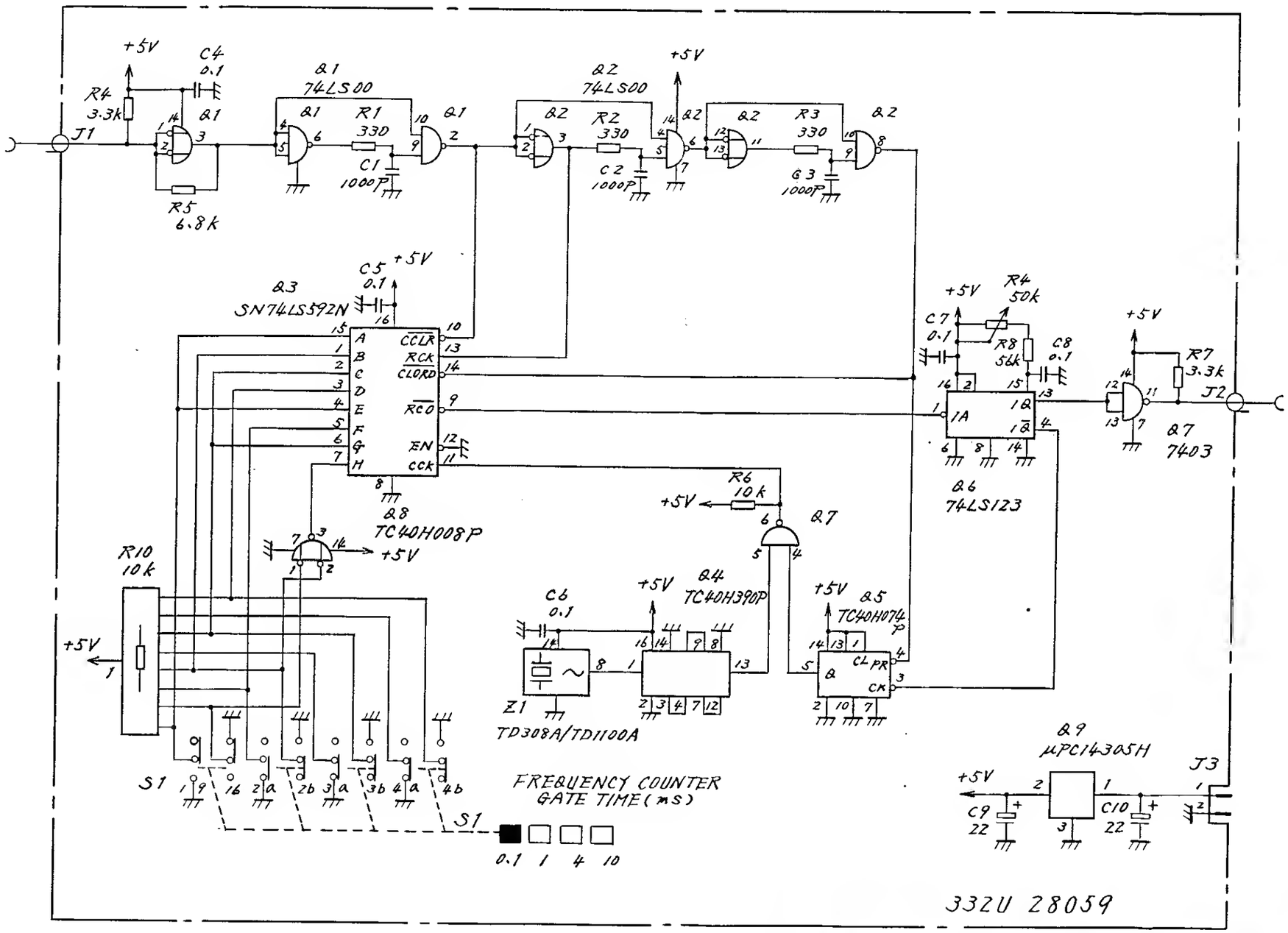
ANRITSU CORP

6-25/6-26

33W28116 1/1

APPLICATION

REVISIONS



12

Parts List | 34W89638

QTY	ITEM	PART No.	DESCRIPTION	MATERIAL	FINISH	NOTE

CHECKED BY | TRACED BY | SCALE

APPROVED BY | DRAWN BY

TITLE: Z3 COUNTER CONTROL Circuit Diagram (MH680B)

DRAWING No. 33W28116 1/1

DEP

No. 0023-1985.08

ANRITSU CORP.

6-27/6-28

SECTION 7

REPLACEABLE PARTS

7.1 Introduction

This section contains information about ordering replacement parts or components. The following tables (Table 7-2 and 7-3) show circuit references (hereafter: CKT REF) and abbreviations used for items in the Parts Lists. The quantity of each item in the Parts List is "one" unless a quantitative description is given in the "NOTE" column.

7.2 Ordering Information

When ordering parts, please supply the following descriptions from the PARTS LIST.

Table 7-1 Ordering Information

No.	Item	Example
1	Instrument name	MH680B Tracking Generator
2	Part location	Part of Z1 RF BLOCK
3	CKT REF	C1
4	Part name	DF553F102PY50 Note: Part name is given in parentheses ( ) in the Parts List. Parts with asterisks* require factory adjustment upon repair. When ordering part(s) marked with asterisk, give full description of the part(s).
5	Quantity	1
6	Instrument serial no.	M31257

When ordering PC boards with parts mounted, please include the Z-number under item(2) above instead of items (3) and (4). (See Table 6-1 for PC board number.)

Table 7-2 Circuit References

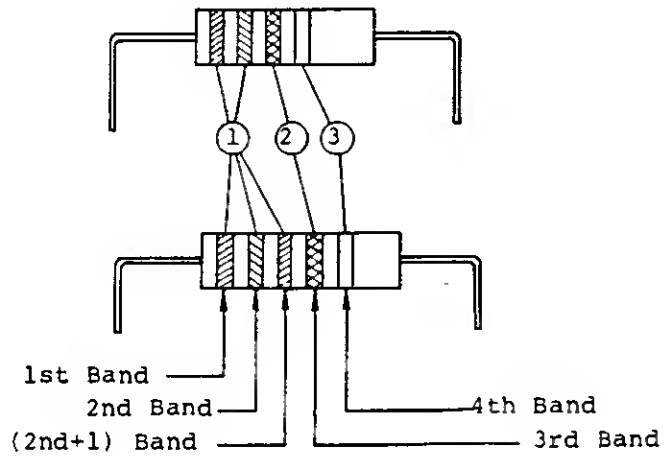
AT:	Attenuator	K:	Relay	Q:	Transistor, diode, IC, rectifier	V:	Neon lamp, vacuum tube
C:	Capacitor	L:	Coil, microinductor	R:	Resistor	X:	Crystal OSC
F:	Fuse	M:	Meter, timer	S:	Switch	Z:	Unit
J:	Jack, plug, connector	P:	Lamp	T:	Transformer		

Table 7-3 Abbreviations

A:	amperes	Multi:	multiplying
Att, R var:	variable attenuator using film elements	N-ch:	N-channel
		non-lin:	non-linear taper
BL:	boundary layer	Non-pol:	non polarity
Cer:	ceramic	NPN:	negative-positive-negative
CF:	carbon film	Ω:	ohms
Comp:	composition	p:	pico (x 10^{-12})
CRT:	cathode-ray tube	Plast:	plastic film
Di:	diode	PMTR:	potentiometer
DIP:	dual in-line package	PNP:	positive-negative-positive
Elect:	electrolytic aluminum	p-p:	peak-to-peak value
F:	farad	RFC:	RF choke
FET:	field-effect transistor	R-lamp:	resistor lamp
G:	ground	rms:	effective value (root-mean-square)
Ge:	germanium	SBD:	Schottky barrier diode
H:	henry	SCR:	silicon-controlled rectifier
Hz:	hertz	Si:	silicon
IC:	integrated circuit	SRD:	step-recovery diode
IEC:	Conforms to IEC Safety Standards.	Tant:	tantalum
J-FET:	junction FET	TM:	time-lag
k:	kilo (x 10^{3})	Tr:	transistor
LED:	light-emitting diode	Trans:	transformer
M:	mega (x 10^{6})	μ:	micro (x 10^{-6})
m:	milli (x 10^{-3})	V:	volt
MF:	metallized film	Var:	variable
MOS-FET:	metal-oxide semiconductor FET	WW:	wire-wound
M paper:	metallized paper	XTAL:	crystal
M plast:	metallized plastic film		

7.3 Reading Capacitance/Resistance

(1) Reading resistance



COLOR	① Figure		② Multiplier	③ Tolerance
	1st	2nd	3rd	4th
Black	0	0	$x10^0$	-
Brown	1	1	$x10^1$	-
Red	2	2	$x10^2$	-
Orange	3	3	$x10^3$	-
Yellow	4	4	$x10^4$	-
Green	5	5	$x10^5$	±0.5%
Blue	6	6	$x10^6$	-
Purple	7	7	$x10^7$	-
Grey	8	8	$x10^8$	-
White	9	9	$x10^9$	-
Gold	-	-	$x10^{-1}$	±5%
Silver	-	-	$x10^{-2}$	±10%
-----	-	-		±20%

For Examples:

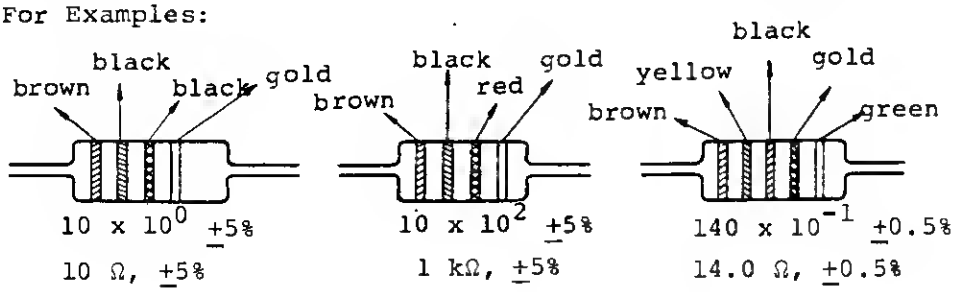
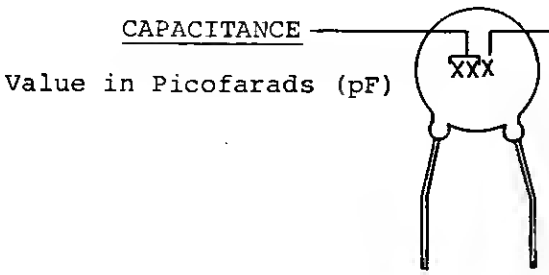


Fig. 7-1 Reading Resistance

(2) Reading capacitance

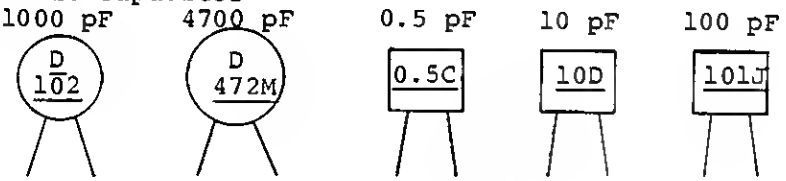


EXAMPLES: 103 = 10,000 pF = 10^{-8} F or 0.01 µF
302 = 3,000 pF = $3x10^{-9}$ F or 0.003 µF
676 = 67,000,000 pF = $67x10^{-6}$ F or 67 µF

(a) Ceramic and polyester capacitors

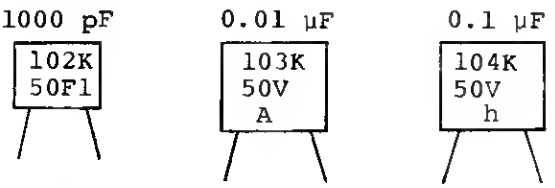
Indication	0.5	1	10	101	102	103	104
Capacity	0.5 pF	1 pF	10 pF	100 pF	1000 pF	0.01 µF	0.1 µF

Example:
Ceramic Capacitor



Capacity values are always underlined.

Polyester Capacitor



(b) Tantalum, metallized, and electrolytic capacitors

Indication	OR47	010	100	101
Capacity	0.47 µF	1 µF	10 µF	100 µF

Fig. 7-2 Reading Capacitance

7.4 Semiconductor Markings

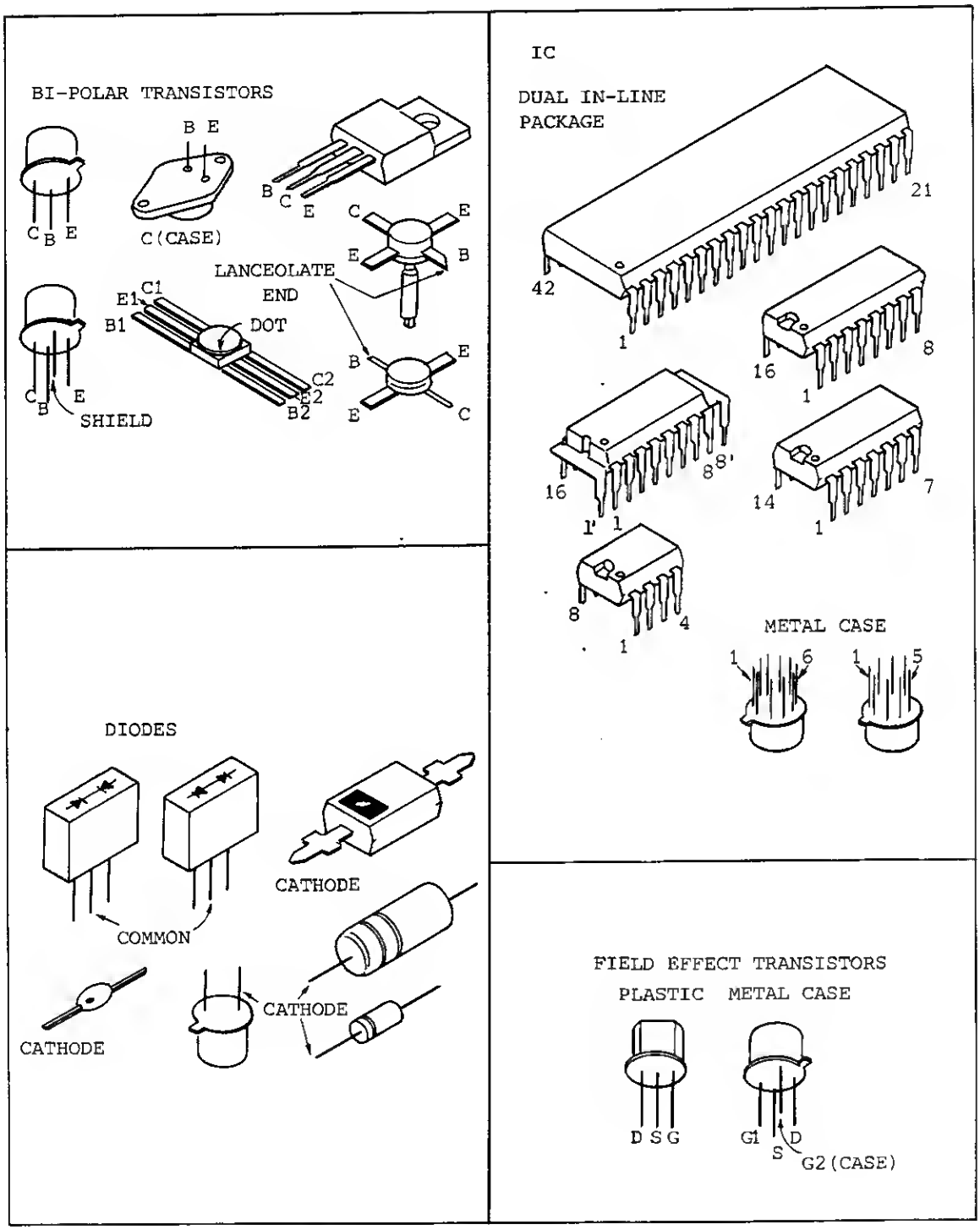


Fig. 7-3 Semiconductor Markings

7.5 Parts List

Table 7-4 Parts List

Circuit Diagram No.	Z No.	Name	Parts List No.
1	——	MH680B TRACKING GENERATOR	34W89637
2	Z1	RF BLOCK	87284
3	Z1/Z1	OUTPUT AMP & DET	87274
4	Z1/Z3	EQUALIZER	87275
5	Z1/Z5	ALC AMP	87276
6	Z1/Z7	CONVERTER	87277
7	Z1/Z8	SECOND LOCAL AMP	87278
8	Z1/Z9	FIRST LOCAL AMP (2)	87279
9	Z1/Z10	FIRST LOCAL AMP (1)	87280
10	Z1/Z11	21.4 MHz P.D.	87281
11	Z2	POWER SUPPLY	87282
12	Z3	COUNTER CONTROL	89638

CKT REF	DESCRIPTION	RATING		NOTE
F 1	Fuse,(MF51NN250V***A AC05)	***A		
F 2	Fuse,(MF51NN250V***A AC05)	***A		
J 1	Adapter,(HRM-511)			
J 2	Plug,(HRM-202B)			
J 3	Plug,(HRM-202B)			
J 4	Connector, (DF1-5S-2.5R24)			
J 5	Inlet,(8843-2.SP.FL. 4/3.64)			
J 6	Power source cable with 3 core, (34J76170)			
J 7	Terminal,(A-12)			
J 8	Connector, (DF1-3S-2.5R24)			
J 9	Connector, (DF1-2S-2.5R24)			
J10	Receptacle,(BNC-R)			
J11	Plug,(27DP-LP-1.5)			
J12	Receptacle,(BNC-R)			
J13	Plug,(27DP-LP-1.5)			
J14	Plug,(BNC-PJ)			
J15	Plug,(BNC-P)			
P 1	Neon lamp, (BNS-3RU-C)			
Q 1	IC, (μPC14315H)			
R 1	MF, (RN14K2E1791D)	1.79kΩ,±0.5%,1/4W		
R 2	Var,MF, (RG161N20SB 10kΩM)	10kΩ,±20%,1/2W		
R 3	Var,MF, (RG161N20SB 10kΩM)	10kΩ,±20%,1/2W		
S 1	Switch,(1852)			

( ): Manufacturer's part number

* : Selected at factory

Parts List : MH680B Tracking Generator 1

CKT REF	DESCRIPTION	RATING		NOTE
T 1	Power trans, (34T87243)			
Z 1	RF Block			
Z 2	Power Supply			
Z 3	Counter Control			

( ): Manufacturer's part number

* : Selected at factory

Parts List : Z1 RF Block (MH680A/B) 2

CKT REF	DESCRIPTION	RATING		NOTE
C 1 to C13	Cer,(DF553F102PY50)	1000pF,+100/-0%,50V		
J 1	Receptacle,(HRM-304B)			
J 2	Receptacle,(HRM-304B)			
J 3	Receptacle,(HRM-305B)			
J 4	Socket, (DF1-5S-2.5R24)			
J 5	Receptacle,(BNC-R)			
Q 1	Di,(1S2208)			
Q 2	Di,(1S2208)			
R 1	CF, (ARD25T151J)	150Ω,±5%,1/4W		
R 2	MF, (RN14K2E1001D)	1kΩ,±0.5%,1/4W		
R 3	MF, (RN14K2E1001D)	1kΩ,±0.5%,1/4W		
R 4	CF, (ARD25T151J)	150Ω,±5%,1/4W		
R 5	CF, (ARD25T101J)	100Ω,±5%,1/4W		
R 6	CF, (ARD25T151J)	150Ω,±5%,1/4W		
Z 1	OUTPUT AMP & DET			34W87274
Z 2	Not assigned			
Z 3	EQUALIZER			34W87275
Z 4	1st MIXER			
Z 5	ALC AMP			34W87276
Z 6	VCO			
Z 7	CONVERTER			34W87277
Z 8	SECOND LOCAL AMP			34W87278
Z 9	FIRST LOCAL AMP (2)			34W87279
Z10	FIRST LOCAL AMP (1)			34W87280
Z11	21.4 MHz P.D.			34W87281
Z12	Noise Filter, (ZFN5101-01R)			
Z13	Noise Filter, (ZFN5101-01R)			

( ): Manufacturer's part number

* : Selected at factory

CKT REF	DESCRIPTION	RATING		NOTE
C 1	Cer,(CK734B1H104K)	0.1μF,±10%,50V		
C 2	Csr,(CC732CJ1H030C)	3pF,±0.25pF,50V		
C 3	Cer,(CK733B1H473K)	0.047μF,±10%,50V		
C 4	Cer,(CK733B1H223K)	0.022μF,±10%,50V		
C 5	Cer,(CK734B1H104K)	0.1μF,±10%,50V		
C 6	Cer,(CK734B1H104K)	0.1μF,±10%,50V		
C 7	Cer,(CC45CK1H020CY)	2pF,±0.25pF,50V		
C 8	Cer,(CK733B1H473K)	0.047μF,±10%,50V		
C 9	Cer,(CK733B1H223K)	0.022μF,±10%,50V		
C10	Cer,(CK734B1H104K)	0.1μF,±10%,50V		
C11	Cer,(CK732B1H102K)	1000pF,±10%,50V		
C12	Cer,(CK734B1H104K)	0.1μF,±10%,50V		
C13	Cer,(CC732CJ1H030C)	3pF,±0.25pF,50V		
C14	Cer,(CK733B1H473K)	0.047μF,±10%,50V		
C15	Cer,(CK733B1H223K)	0.022μF,±10%,50V		
C16	Cer,(CK734B1H104K)	0.1μF,±10%,50V		
C17	Cer,(CC45CK1H020CY)	2pF,±0.25pF,50V		
C18	Cer,(CK733B1H473K)	0.047μF,±10%,50V		
C19	Cer,(CK733B1H223K)	0.022μF,±10%,50V		
C20	Cer,(CK734B1H104K)	0.1μF,±10%,50V		
C21	Cer,(CK732B1H102K)	1000pF,±10%,50V		
C22	Cer,(DF553F102PY50)	1000pF,+100/-0%,50V		
C23	Cer,(CK734B1H104K)	0.1μF,±10%,50V		
C24	Cer,(CC45CJ1H030CY)	3pF,±0.25pF,50V		
C25	Cer,(CK733B1H473K)	0.047μF,±10%,50V		
C26	Cer,(CK734B1H104K)	0.1μF,±10%,50V		
C27	Cer,(CK737B1H224K)	0.22μF,±10%,50V		
C28	Cer,(CK732B1H102K)	1000pF,±10%,50V		
C29	Cer,(CK734B1H104K)	0.1μF,±10%,50V		
C30	Cer,(CC732CK1H0R5C)	0.5pF,±0.25pF,50V		
C31	Not assigned			
C32	Cer,(CK924C1H104M)	0.1μF,±20%,50V		
C33	Cer,(CK924C1H104M)	0.1μF,±20%,50V		
C34	Cer,(CK732B1H102K)	1000pF,±10%,50V		
C35	Cer,(CK924C1H104M)	0.1μF,±20%,50V		
C36	Cer,(CK924C1H102M)	1000pF,±20%,50V		
C37	Cer,(CK924C1H104M)	0.1μF,±20%,50V		
C38	Cer,(CK924C1H104M)	0.1μF,±20%,50V		
L 1	Coil,(SP0408-R10M)	0.1μH		

( ): Manufacturer's part number

* : Selected at factory

CKT REF	DESCRIPTION	RATING		NOTE
Q 1	Tr,(2SC2585)			
Q 2	Di,breakdown,(RD3.9EB)	3.7 to 4.1V,400mW		
Q 3	Di,breakdown,(RD3.9EB)	3.7 to 4.1V,400mW		
Q 4	Tr,(2SC2585)			
Q 5	Di,breakdown,(RD5.1EB)	4.8 to 5.4V,400mW		
Q 6	Di,breakdown,(RD5.1EB)	4.8 to 5.4V,400mW		
Q 7	Tr,(2SC2585)			
Q 8	Di,breakdown,(RD3.9EB)	3.7 to 4.1V,400mW		
Q 9	Di,breakdown,(RD3.9EB)	3.7 to 4.1V,400mW		
Q10	Tr,(2SC2585)			
Q11	Di,breakdown,(RD5.1EB)	4.8 to 5.4V,400mW		
Q12	Di,breakdown,(RD5.1EB)	4.8 to 5.4V,400mW		
Q13	Tr,(2SC2585)			
Q14	Di,breakdown,(RD9.1EB)	8.5 to 9.6V,400mW		
Q15	Di,(1SS14)			
Q16	IC, (μPC354D)			
Q17	Di,(1SS99)			
Q18	Di,(1S953)			
Q19	IC, (μPC258C)			
Q20	Not assigned			
Q21	Di,(1S953)			
Q22	Di,breakdown,(RD6.2EB)	5.8 to 6.6V,400mW		
R 1	MF, (RM73B2B 330JD)	33Ω,±5%,1/8W		
R 2	MF, (RM73B2B 331JD)	330Ω,±5%,1/8W		
R 3	MF, (RM73B2B 221JD)	220Ω,±5%,1/8W		
R 4	MF, (RM73B2B 181JD)	180Ω,±5%,1/8W		
R 5	MF, (RM73B2B 270JD)	27Ω,±5%,1/8W		
R 6	MF, (RM73B2B 471JD)	470Ω,±5%,1/8W		
R 7	MF, (RM73B2B 390JD)	39Ω,±5%,1/8W		
R 8	MF,(RM63B2B 331JD)	330Ω,±5%,1/8W		
R 9	MF, (RM73B2B 560JD)	56Ω,±5%,1/8W		
R10	MF, (RM73B2B 181JD)	180Ω,±5%,1/8W		
R11	MF, (RM73B2B 680JD)	68Ω,±5%,1/8W		
R12	MF, (RM73B2B 221JD)	220Ω,±5%,1/8W		
R13	MF, (RM73B2B 150JD)	15Ω,±5%,1/8W		
R14	MF, (RM73B2B 220JD)	22Ω,±5%,1/8W		
R15	MF, (RM73B2B 181JD)	180Ω,±5%,1/8W		
R16	MF, (RM73B2B 330JD)	33Ω,±5%,1/8W		
R17	MF, (RM73B2B 331JD)	330Ω,±5%,1/8W		
R18	MF, (RM73B2B 221JD)	220Ω,±5%,1/8W		
R19	MF, (RM73B2B 181JD)	180Ω,±5%,1/8W		
R20	MF, (RM73B2B 270JD)	27Ω,±5%,1/8W		

( ): Manufacturer's part number

* : Selected at factory

CKT REF	DESCRIPTION	RATING		NOTE
R21	MF, (RM73B2B 471JD)	470Ω,±5%,1/8W		
R22	MF, (RM73B2B 390JD)	39Ω,±5%,1/8W		
R23	MF, (RM73B2B 331JD)	330Ω,±5%,1/8W		
R24	MF, (RM73B2B 560JD)	56Ω,±5%,1/8W		
R25	MF, (RM73B2B 181JD)	180Ω,±5%,1/8W		
R26	MF, (RM73B2B 680JD)	68Ω,±5%,1/8W		
R27	MF, (RM73B2B 221JD)	220Ω,±5%,1/8W		
R28	MF, (RM73B2B 150JD)	15Ω,±5%,1/8W		
R29	MF, (RM73B2B 220JD)	22Ω,±5%,1/8W		
R30	MF, (RM73B2B 181JD)	180Ω,±5%,1/8W		
R31	MF, (RM73B2B 390JD)	39Ω,±5%,1/8W		
R32	MF, (RM73B2B 331JD)	330Ω,±5%,1/8W		
R33	MF, (RM73B2B 560JD)	56Ω,±5%,1/8W		
R34	MF, (RM73B2B 181JD)	180Ω,±5%,1/8W		
R35	MF, (RM73B2B 680JD)	68Ω,±5%,1/8W		
R36	MF, (RM73B2B 121JD)	120Ω,±5%,1/8W		
R37	MF, (RM73B2B 101JD)	100Ω,±5%,1/8W		
R38	MF, (RM73B2B 471JD)	470Ω,±5%,1/8W		
R39	MF, (RM73B2B 471JD)	470Ω,±5%,1/8W		
R40	MF, (RM73B2B 152JD)	1.5kΩ,±5%,1/8W		
R41	Not assigned			
R42	MF, (RM73B2B 104JD)	100kΩ,±5%,1/8W		
R43	MF, (RM14K2E1101D)	1.1kΩ,±0.5%,1/4W		
R44	MF, (RN14K2E2211D)	2.21kΩ,±0.5%,1/4W		
R45	MF, (RN14K2E4221D)	4.22kΩ,±0.5%,1/4W		
R46	MF, (RN14K2E6830D)	683Ω,±0.5%,1/4W		
R47	MF, (RN14K2E1500D)	150Ω,±0.5%,1/4W		
R48	CF, (ARD25T103J)	10kΩ,±5%,1/4W		
R49	CF, (ARD25T473J)	47kΩ,±5%,1/4W		
R50	MF, (RN14K2E1002D)	10kΩ,±0.5%,1/4W		
R51	Var,MF, (RJ-6P 503)	50kΩ,1/2W		
R52	MF, (RN14K2E1243D)	124kΩ,±0.5%,1/4W		
R53	CF, (ARD25T682J)	6.8kΩ,±5%,1/4W		
R54	CF, (ARD25T472J)	4.7kΩ,±5%,1/4W		
R55	CF, (ARD25T822J)	8.2kΩ,±5%,1/4W		
R56	CF, (ARD25T222J)	2.2kΩ,±5%,1/4W		
R57	CF, (ARD25T103J)	10kΩ,±5%,1/4W		
R58	CF, (ARD25T102J)	1kΩ,±5%,1/4W		
R59	CF, (ARD25T472J)	4.7kΩ,±5%,1/4W		
R60	Var,MF, (RJ-6P 103)	10kΩ,1/2W		
R61	MF, (RM73B2B 500JD)	50Ω,±5%,1/8W		
R62	CF, (ARD25T332J)	3.3kΩ,±5%,1/4W		
R63	MF, (RN14K2E1003D)	100kΩ,±0.5%,1/4W		

( ) : Manufacturer's part number

* : Selected at factory

CKT REF	DESCRIPTION	RATING		NOTE
C 1	Cer,(CC45CK1H020CY)	2pF,±0.25pF,50V		
C 2	Cer,(CC45CK1H0R5CY)	0.5pF,±0.25pF,50V		
C 3	Cer,(CC45CK1H0R5CY)	0.5pF,±0.25pF,50V		
R 1	MF, (RM73B2B180JD)	18Ω,±5%,1/8W		
R 2	MF, (RM73B2B271JD)	270Ω,±5%,1/8W		
R 3	MF, (RM73B2B271JD)	270Ω,±5%,1/8W		
Z 1	Low pass filter			

( ): Manufacturer's part number

* : Selected at factory

CKT REF	DESCRIPTION	RATING		NOTE
C 1	Cer,(CC732CH1H101J)	100pF,±5%,50V		
C 2	Cer,(CC732CH1H101J)	100pF,±5%,50V		
C 3	Cer,(CC732CH1H100D)	10pF,±0.5pF,50V		
C 4	Cer,(CC732CK1H0R5C)	0.5pF,±0.25pF,50V		
C 5	Cer,(CC732CK1H010C)	1pF,±0.25pF,50V		
C 6	Cer,(CC732CK1H0R5C)	0.5pF,±0.25pF,50V		
Q 1	FET, (3SK129-R)			
Q 2	Di,breakdown,(RD6.2EB)	5.8 to 6.6V,400mW		
R 1	MF, (RM73B2B180JD)	18Ω,±5%,1/8W		
R 2	MF, (RM73B2B271JD)	270Ω,±5%,1/8W		
R 3	MF, (RM73B2B271JD)	270Ω,±5%,1/8W		
R 4	MF, (RM73B2B470JD)	47Ω,±5%,1/8W		
R 5	MF, (RM73B2B560JD)	56Ω,±5%,1/8W		
R 6	MF, (RM73B2B101JD)	100Ω,±5%,1/8W		
R 7	MF, (RM73B2B101JD)	100Ω,±5%,1/8W		
R 8	MF, (RM73B2B470JD)	47Ω,±5%,1/8W		
R 9	CF, (ARD25T102J)	1kΩ,±5%,1/4W		
R10	CF, (ARD25T681J)	680Ω,±5%,1/4W		
R11	MF, (RM73B2B680JD)	68Ω,±5%,1/8W		
R12	MF, (RM73B2B101JD)	100Ω,±5%,1/8W		
R13	MF, (RM73B2B101JD)	100Ω,±5%,1/8W		

( ): Manufacturer's part number

* : Selected at factory

CKT REF	DESCRIPTION	RATING		NOTE
C 1	Cer,(CC732CH1H220J)	22pF,±5%,50V		
C 2	Not assigned			
C 3	Cer,(CK924C1H103M)	0.01μF,±20%,50V		
C 4	Cer,(CC732CH1H101J)	100pF,±5%,50V		
C 5	Cer,(CC732CH1H220J)	22pF,±5%,50V		
Q 1	Di,breakdown,(RD6.2EB)	5.8 to 6.6V,400mW		
Q 2	Tr,(2SC2367)			
Q 3	Di,(ND487R2-3P)			34P73171
Q 4	Di,(ND487R2-3P)			34P73171
R 1	CF, (ARD25T182J)	1.8kΩ,±5%,1/4W		
R 2	CF, (ARD25T181J)	180Ω,±5%,1/4W		
R 3	MF, (RM73B2B680JD)	68Ω,±5%,1/8W		
R 4	MF, (RM73B2B101JD)	100Ω,±5%,1/8W		
R 5	MF, (RM73B2B101JD)	100Ω,±5%,1/8W		
T 1	Trans,(342T74443)			

( ): Manufacturer's part number

* : Selected at factory

CKT REF	DESCRIPTION	RATING		NOTE
C 1	Cer,(CC732CK1H020C)	2pF,±0.25pF,50V		
C 2	Cer,(CC732B1H102K)	1000pF,±10%,50V		
C 3	Cer,(CC732B1H102K)	1000pF,±10%,50V		
C 4	Cer,(CC732CK1H020C)	2pF,±0.25pF,50V		
C 5	Cer,(CC732B1H102K)	1000pF,±10%,50V		
C 6	Cer,(CC732B1H102K)	1000pF,±10%,50V		
C 7	Cer,(CC732CK1H020C)	2pF,±0.25pF,50V		
C 8	Cer,(CK924C1H104M)	0.1μF,±20%,50V		
Q 1	Tr,(2SC2585)			
Q 2	Tr,(FJ451LE)			
Q 3	Di,breakdown,(RD7.5EB)	7.0 to 7.9V,400mW		
Q 4	Di,breakdown,(RD11EB)	10.4 to 11.6V,400mW		
Q 5	Di,breakdown,(RD6.2EB)	5.8 to 6.6V,400mW		
Q 6	FET, (3SK129-R)			
R 1	MF, (RM73B2B152JD)	1.5kΩ,±5%,1/8W		
R 2	MF, (RM73B2B102JD)	1kΩ,±5%,1/8W		
R 3	MF, (RM73B2B7R5JD)	7.5Ω,±5%,1/8W		
R 4	MF, (RM73B2B390JD)	39Ω,±5%,1/8W		
R 5	MF, (RM73B2B151JD)	150Ω,±5%,1/8W		
R 6	MF, (RM73B2B5R1JD)	5.1Ω,±5%,1/8W		
R 7	MF, (RM73B2B471JD)	470Ω,±5%,1/8W		
R 8	MF, (RM73B2B470JD)	47Ω,±5%,1/8W		

( ): Manufacturer's part number

* : Selected at factory

CKT REF	DESCRIPTION	RATING		NOTE
C 1	Cer,(CC732CK1H020C)	2pF,±0.25pF,50V		
C 2	Cer,(CC732CK1H010C)	1pF,±0.25pF,50V		
C 3	Cer,(CC732B1H102K)	1000pF,±10%,50V		
C 4	Cer,(CC732B1H102K)	1000pF,±10%,50V		
C 5	Cer,(CC732CK1H020C)	2pF,±0.25pF,50V		
C 6	Cer,(CC732B1H102K)	1000pF,±10%,50V		
C 7	Cer,(CK924C1H104M)	0.1µF,±20%,50V		
C 8	Cer,(CC732CK1H010C)	1pF,±0.25pF,50V		
C 9	Cer,(CC732B1H102K)	1000pF,±10%,50V		
Q 1	Tr,(2SC2585)			
Q 2	Tr,(FJ451LE)			
Q 3	Di,breakdown,(RD7.5EB)	7.0 to 7.9V,400mW		
Q 4	Di,breakdown,(RD11EB)	10.4 to 11.6V,400mW		
R 1	MF, (RM73B2B180JD)	18Ω,±5%,1/8W		
R 2	MF, (RM73B2B271JD)	270Ω,±5%,1/8W		
R 3	MF, (RM73B2B271JD)	270Ω,±5%,1/8W		
R 4	MF, (RM73B2B470JD)	47Ω,±5%,1/8W		
R 5	MF, (RM73B2B511JD)	510Ω,±5%,1/8W		
R 6	MF, (RM73B2B101JD)	100Ω,±5%,1/8W		
R 7	MF, (RM73B2B331JD)	330Ω,±5%,1/8W		
R 8	MF, (RM73B2B391JD)	390Ω,±5%,1/8W		
R 9	MF, (RM73B2B101JD)	100Ω,±5%,1/8W		
R10	MF, (RM73B2B121JD)	120Ω,±5%,1/8W		

( ): Manufacturer's part number

* : Selected at factory

CKT REF	DESCRIPTION	RATING		NOTE
C 1	Cer,(CC732CK1H020C)	2pF,±0.25pF,50V		
C 2	Cer,(CC732CK1H010C)	1pF,±0.25pF,50V		
C 3	Cer,(CC732B1H102K)	1000pF,±10%,50V		
C 4	Cer,(CC732B1H102K)	1000pF,±10%,50V		
C 5	Cer,(CC732CK1H020C)	2pF,±0.25pF,50V		
C 6	Cer,(CC732B1H102K)	1000pF,±10%,50V		
C 7	Cer,(CK924C1H104M)	0.1μF,±20%,50V		
C 8	Cer,(CC732CK1H010C)	1pF,±0.25pF,50V		
C 9	Cer,(CC732B1H102K)	1000pF,±10%,50V		
Q 1	Tr,(2SC2585)			
Q 2	Tr,(FJ451LE)			
Q 3	Di,breakdown,(RD7.5EB)	7.0 to 7.9V,400mW		
Q 4	Di,breakdown,(RD11EB)	10.4 to 11.6V,400mW		
R 1	MF, (RM73B2B180JD)	18Ω,±5%,1/8W		
R 2	MF, (RM73B2B271JD)	270Ω,±5%,1/8W		
R 3	MF, (RM73B2B271JD)	270Ω,±5%,1/8W		
R 4	MF, (RM73B2B470JD)	47Ω,±5%,1/8W		
R 5	MF, (RM73B2B511JD)	510Ω,±5%,1/8W		
R 6	MF, (RM73B2B101JD)	100Ω,±5%,1/8W		
R 7	MF, (RM73B2B331JD)	330Ω,±5%,1/8W		
R 8	MF, (RM73B2B391JD)	390Ω,±5%,1/8W		
R 9	MF, (RM73B2B101JD)	100Ω,±5%,1/8W		
R10	MF, (RM73B2B121JD)	120Ω,±5%,1/8W		

( ): Manufacturer's part number

* : Selected at factory

Parts List : Z1/Z11 21.4 MHz P.D. (MH680A/B)

CKT REF	DESCRIPTION	RATING		NOTE
C 1	Cer,(CC924CH1H471J)	470pF,±5%,50V		
C 2	Cer,(CK924C1H103M)	0.01μF,±20%,50V		
C 3	Cer,(CK924C1H103M)	0.01μF,±20%,50V		
C 4	Cer,(CC924CH1H471J)	470pF,±5%,50V		
C 5	Cer,(CK924C1H103M)	0.01μF,±20%,50V		
C 6	Cer,(CK924C1H103M)	0.01μF,±20%,50V		
C 7	Cer,(CC924CH1H471J)	470pF,±5%,50V		
C 8	Cer,(CK924C1H103M)	0.01μF,±20%,50V		
C 9	Cer,(CK924C1H103M)	0.01μF,±20%,50V		
C10	Cer,(CC924CH1H471J)	470pF,±5%,50V		
C11	Elect,(CE04W1V100)	10μF,±20%,35V		
C12	Cer,(CK924C1H104M)	0.1μF,±20%,50V		
C13	Cer,(CK924C1H104M)	0.1μF,±20%,50V		
C14	Cer,(CC45CH1H220JY)	22pF,±5%,50V		
C15	Cer,(CC45CH1H680JY)	68pF,±5%,50V		
C16	Cer,(CC45CH1H680JY)	68pF,±5%,50V		
C17	Cer,(CK924C1H104M)	0.1μF,±20%,50V		
C18	Cer,(CC924CH1H471J)	470pF,±5%,50V		
C19	Cer,(CK924C1H104M)	0.1μF,±20%,50V		
C20	Cer,(CK45CH1H470JY)	47pF,±5%,50V		
C21	Cer,(CK45CH1H470JY)	47pF,±5%,50V		
C22	Cer,(CK924C1H104M)	0.1μF,±20%,50V		
C23	Cer,(CK924C1H104M)	0.1μF,±20%,50V		
C24	Cer,(CK924C1H104M)	0.1μF,±20%,50V		
C25	Cer,(CK924C1H102M)	1000pF,±20%,50V		
C26	Elect,(CE04W1V100)	10μF,±20%,35V		
L 1	Coil,(LF8-101K)	100μH		
L 2	Coil,(SP0408-R10M)	0.1μH		
Q 1	Di,breakdown,(RD5.1EB)	4.8 to 5.4V,400mW		
Q 2	Tr,(2SC2369)			
Q 3	Di,breakdown,(RD5.1EB)	4.8 to 5.4V,400mW		
Q 4	Tr,(2SC2369)			
Q 5	Di,breakdown,(RD5.1EB)	4.8 to 5.4V,400mW		
Q 6	Tr,(2SC2369)			
Q 7	Tr,(2SC2369)			
Q 8	IC, (74LS390)			
Q 9	IC, (μPC14305H)			
Q10	Di,(FC53M)			
Q11	Not assigned			
Q12	Tr,(2SC2369)			
Q13	Tr,(2SC2369)			
Q14	Tr,(2SC2369)			

( ): Manufacturer's part number

* : Selected at factory

Parts List : Z1/Z11 21.4 MHz P.D. (MH680A/B)

CKT REF	DESCRIPTION	RATING		NOTE
Q15	IC, (MC4044P)			
Q16	IC, (μPC258C)			
R 1	CF, (ARD25T220J)	22Ω,±5%,1/4W		
R 2	CF, (ARD25T681J)	680Ω,±5%,1/4W		
R 3	CF, (ARD25T182J)	1.8kΩ,±5%,1/4W		
R 4	CF, (ARD25T100J)	10Ω,±5%,1/4W		
R 5	CF, (ARD25T470J)	47Ω,±5%,1/4W		
R 6	CF, (ARD25T681J)	680Ω,±5%,1/4W		
R 7	CF, (ARD25T182J)	1.8kΩ,±5%,1/4W		
R 8	CF, (ARD25T100J)	10Ω,±5%,1/4W		
R 9	CF, (ARD25T560J)	56Ω,±5%,1/4W		
R10	CF, (ARD25T821J)	820Ω,±5%,1/4W		
R11	CF, (ARD25T471J)	470Ω,±5%,1/4W		
R12	CF, (ARD25T151J)	150Ω,±5%,1/4W		
R13	CF, (ARD25T102J)	1kΩ,±5%,1/4W		
R14	CF, (ARD25T682J)	6.8kΩ,±5%,1/4W		
R15	CF, (ARD25T471J)	470Ω,±5%,1/4W		
R16	Not assigned			
R17	CF, (ARD25T223J)	22kΩ,±5%,1/4W		
R18	CF, (ARD25T103J)	10kΩ,±5%,1/4W		
R19	CF, (ARD25T103J)	10kΩ,±5%,1/4W		
R20	CF, (ARD25T102J)	1kΩ,±5%,1/4W		
R21	CF, (ARD25T101J)	100Ω,±5%,1/4W		
R22	CF, (ARD25T102J)	1kΩ,±5%,1/4W		
R23	CF, (ARD25T331J)	330Ω,±5%,1/4W		
R24	CF, (ARD25T101J)	100Ω,±5%,1/4W		
R25	CF, (ARD25T682J)	6.8kΩ,±5%,1/4W		
R26	CF, (ARD25T102J)	1kΩ,±5%,1/4W		
R27	CF, (ARD25T471J)	470Ω,±5%,1/4W		
R28	CF, (ARD25T102J)	1kΩ,±5%,1/4W		
R29	CF, (ARD25T102J)	1kΩ,±5%,1/4W		
R30	CF, (ARD25T105J)	1MΩ,±5%,1/4W		
R31	CF, (ARD25T102J)	1kΩ,±5%,1/4W		
R32	CF, (ARD25T103J)	10kΩ,±5%,1/4W		
R33	CF, (ARD25T271J)	270Ω,±5%,1/4W		
R34	CF, (ARD25T102J)	1kΩ,±5%,1/4W		
R35	CF, (ARD25T101J)	100Ω,±5%,1/4W		
X 1	XTAL OSC	21.4 MHz		

( ): Manufacturer's part number

* : Selected at factory

Parts List : Z2 POWER SUPPLY (MH680A/B)

CKT REF	DESCRIPTION	RATING		NOTE
C 1	M Plast, (CF922N2A105K)	1μF,±10%,100V		
C 2	M Plast, (CF922N2A105K)	1μF,±10%,100V		
C 3	Elect,(CE02W1V222)	2200μF,±20%,35V		
C 4	Elect,(CE02W1V222)	2200μF,±20%,35V		
C 5	Elect,(CE04W1V220)	22μF,±20%,35V		
C 6	Elect,(CE04W1V220)	22μF,±20%,35V		
F 1	Fuse,(MF51NN250V 0.5A DC01)	0.5A		
F 2	Fuse,(MF51NN250V 0.1A DC01)	0.1A		
J 1	Connector, (DF1-5P-2.5DSA)			
J 2	Connector, (DF1-5P-2.5DSA)			
J 3	Connector, (DF1-3P-2.5DSA)			
M 1	Timer,(TM-O)	10000 H		
Q 1	Rectifier, (RM-152-LFD)			
Q 2	Rectifier, (RM-152-LFD)			
Q 3	IC, (μPC16315H)			
R 1	WW, (ERF-2SKR51)	0.51Ω,±10%,2W		
R 2	WW, (ERF-2SKR51)	0.51Ω,±10%,2W		
R 3	CF, (ARD25T223J)	22kΩ,±5%,1/4W		
R 4	CF, (ARD25T102J)	1kΩ,±5%,1/4W		
R 5	CF, (ARD25T105J)	1MΩ,±5%,1/4W		
R 6	CF, (ARD25T222J)	2.2kΩ,±5%,1/4W		

( ): Manufacturer's part number

* : Selected at factory

Parts List : Z3 COUNTER CONTROL (MH680B)

CKT REF	DESCRIPTION	RATING		NOTE
C 1	Cer,(CC924CH1H102J)	1000pF,±5%,50V		
C 2	Cer,(CC924CH1H102J)	1000pF,±5%,50V		
C 3	Cer,(CC924CH1H102J)	1000pF,±5%,50V		
C 4	Cer,(CK924F1H104Z)	0.1μF,+80/-20%,50V		
C 5	Cer,(CK924F1H104Z)	0.1μF,+80/-20%,50V		
C 6	Cer,(CK924F1H104Z)	0.1μF,+80/-20%,50V		
C 7	Cer,(CK924F1H104Z)	0.1μF,+80/-20%,50V		
C 8	Plast,(ECQ-P1 104FZ)	0.1μF,±1%,100V		
C 9	Elect,(CE04W1V220)	22μF,±20%,35V		
C10	Elect,(CE04W1V220)	22μF,±20%,35V		
J 1	Connector, (27DP-R-PC-1)			
J 2	Connector, (27DP-R-PC-1)			
J 3	Connector, (DF1-2P-2.5DSA)			
Q 1	IC, (74LS00)			
Q 2	IC, (74LS00)			
Q 3	IC, (SN74LS592N)			
Q 4	IC, (TC40H390P)			
Q 5	IC, (TC40H074P)			
Q 6	IC, (74LS123)			
Q 7	IC, (7403)			
Q 8	IC, (TC40H008P)			
Q 9	IC, (μPC14305H)			
R 1	CF, (ARD25T331J)	330Ω,±5%,1/4W		
R 2	CF, (ARD25T331J)	330Ω,±5%,1/4W		
R 3	CF, (ARD25T331J)	330Ω,±5%,1/4W		
R 4	CF, (ARD25T332J)	3.3kΩ,±5%,1/4W		
R 5	CF, (ARD25T682J)	6.8kΩ,±5%,1/4W		
R 6	CF, (ARD25T103J)	10kΩ,±5%,1/4W		
R 7	CF, (ARD25T332J)	3.3kΩ,±5%,1/4W		
R 8	CF, (ARD25T563J)	56kΩ,±5%,1/4W		
R 9	Var,MF, (RJ-6P 50kΩ)	50kΩ,1/2W		
R10	Single in-line array, (IHR-8-103JA)	10kΩ x 8,1/8W		
S 1	Pushbutton,(4F150UGr)			

( ): Manufacturer's part number

* : Selected at factory

CKT REF	DESCRIPTION	RATING		NOTE
Z 1	XTAL OSC, (TD308A/TD1100A)			

( ): Manufacturer's part number

* : Selected at factory